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Contributions of the Engineer to Public Health Conservation*

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FROM the point of view of origin, all human diseases may be grouped into two general classes: those which are constitutional, whose causes arise primarily within the body itself, and those which are environmental, whose causes enter the body from without. The prevention of the first class of diseases calls for the improvement of the individual organism under the guidance of the physician, aided by the biologist, the physiologist and the hygienist. The prevention of the second class of diseases calls for the improvement of the environment of the social organism under the guidance of the engineer, aided by the chemist and the bacteriologist.

The engineer is one who utilizes the materials, forces and phenomena of nature for the advancement of the well-being of mankind. He who practices in the sanitary branch of engineering is concerned fundamentally with improving man's environment and thereby promoting public health, comfort and convenience.

The growth of modern civilization has been accompanied by an increasing concentration of persons in cities and towns, which has called for every-growing attention to the sanitation of the environment, in order to conserve the public health. The ravages of typhoid and cholera have been eliminated in marked degree from the cities of civilized countries, an achievement toward which the engineer has made an important contribution by providing for safe water supplies and appropriate disposal of human wastes.

WATER SUPPLY

There is evidence to show that, even in ancient times, the value of a supply of potable water was appreciated. In Egypt near the pyramids of Gizeh, which were built about 3000 B.C., is the well of Joseph.

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It is excavated through solid rock to a depth of nearly 300 feet, no mean engineering feat for those times. About 2800 B.C., the Chinese were sinking wells 1,500 feet in depth, probably the deepest wells of all antiquity. A little later, about 2000 B.C., water was brought from long distances in open channels to the cities of Babylon and Nineveh.

At Jerusalem, in 727 B.C., King Hezekiah built a vast reservoir, called the pool of Siloam, near the city gates. Due to the insufficiency of the existing water supply, the king's engineers were required to build a tunnel through solid rock behind the city. The work was done with hand tools only and was carried out from both ends.

Ancient Greece and Rome also witnessed the construction of great water-supply works. In 625 B.C., an engineer named Eupalinius constructed a tunnel 4,200 feet long in order to supply water to the city of Athens. In 312 B.C., the first Roman aqueduct was built by Appius Claudius. This stone water pipe was about ten miles in length, most of it underground. It was followed by many other notable aqueducts, not only in the vicinity of Rome, but in various parts of Europe and Africa. Some of these ancient structures are still in use.

Following the fall of the Roman Empire, there was a period of more than 1,000 years of intellectual darkness, during which no material progress was made. In the field of water supply, the world forgot the lessons taught by the ancients and reverted for the most part to carrying water from the nearest source, whether polluted or not. In London, England, for example, the first semblance of a public water supply made its appearance in the year 1235, when small quantities of spring water were brought to the city through lead pipes and masonry conduits. In 1582, a Dutch engineer named Peter Morrys erected water-wheels on London Bridge to pump water into the city from the Thames. This system supplied part of the city for 240 years. In 1619 the New River Company was incorporated and laid its pipes throughout the city. It received its supply from the New River, and for the first time the general principle was adopted of supplying each house with water.

The application of steam to water-pumping in the 18th century gave a great impetus to the development of waterworks. Probably the first use of steam for this purpose was in London in 1761.

One of the water companies supplying London at the beginning of the 19th century was the Chelsea Company, which took water from the Thames at Chelsea. With the growth in population along the river and the increase in quantities of filth emptied into it, the water became more and more turbid and contaminated. It finally became necessary for the Chelsea Company to take steps toward improving the quality of the water, and sedimentation in reservoirs was tried. As this method afforded insufficient purification, glow and sand filters were installed in 1829 by James Simpson, an engineer. This is the first recorded instance of the filtration of water on a large scale, and it was successful in removing turbidity. Its value also in improving the water from an

hygienic standpoint was appreciated, although the principles underlying its action were not understood until some years later.

As a consequence of the good results obtained from the Chelsea filter, the filtration of all river-water supplies of London was made compulsory by law in 1855, although this law did not become fully effective until several years later. In 1866 an epidemic of Asiatic cholera occurred in the eastern districts of the city. An investigation of its origin and distribution served to fasten the blame upon the pollution of a portion of the public water supply derived from the river Lea. The value of filtration became manifest, for evidently it was only the unfiltered river water which did harm. The supply which was pumped from the Lea and filtered seems to have caused no spread of the disease.

When efficient chemical methods of water analysis were devised about 1870 and applied to the subject of filtration, it was found that but little chemical purification was effected by the process. The result was disappointing, as the organic matter itself was considered at that time to be a chief cause of disease. After the establishment of the germ theory of disease, however, and the application of modern bacteriological methods to water filtration in 1885 by Percy F. Frankland, a professor of chemistry, it was found that the sand filter was an excellent medium for removing bacteria from water. This was followed by the development in the United States of the rapid sandfilter commonly called the mechanical filter which revolutionized the art of water filtration. Since that time many sand filters have been designed and built by engineers in Europe and on this continent and have contributed notably to the conservation of the public health.

The removal of disease germs from water by filters is accomplished by mechanical straining. The efficiency and dependability of such treatment can be increased by supplementary treatment of the water with minute quantities of chlorine for the purpose of killing germs. The first systematic application of a chlorine compound to a large water supply was made at Lincoln, England, during a typhoid epidemic in 1905, by Alexander C. Houston, now Sir Alexander Houston, and George McGowan, bacteriologist and chemist, respectively, to the Royal Commission on Sewage Disposal. Investigations on the continuous application of small quantities of chlorine in the form of bleaching powder to the water supply of Jersey City, N.J., in 1908, and the successful employment of this chemical in the same year in the highly polluted water of Bubbly Creek, at the purification plant in the stockyards of Chicago, Ill., established in the United States the disinfecting value of chlorine. More recently, liquid chlorine has superseded bleaching powder for use in disinfecting public water supplies.

The physical quality of water has an indirect bearing upon public health, for in case of bad-tasting or ill-smelling water people may resort to palatable but dangerous supplies from polluted sources. The

demand for water of attractive quality has led to much activity during the past few years in taste and odour control. Notable among the methods used are chlor-amine treatment and superchlorination followed by dechlorination. Chlor-amine was used at Ottawa by Joseph Race as long ago as 1916, and superchlorination with subsequent dechlorination first was started on a regular basis at Toronto by Norman J. Howard in 1927.

During the past fifty years there has been a steady decrease in typhoid fever in Canada and the United States, largely as a result of improvement in the quality of drinking water furnished to city dwellers, although other factors have contributed to the result. Thirty to forty years ago it was common in the cities of the United States to have each year from 25 to 135 deaths from typhoid fever for each 100,000 of population, while during 1930 the rate averaged only 1.6 deaths in 78 large cities.

Although it is still highly desirable to obtain as pure a natural water as is financially practicable, the engineer has made it possible so to treat contaminated waters that they will be safe, judged by prevailing standards of bacterial purity. However, conditions arise from time to time which indicate that the limits of our present knowledge of water purification need to be extended.

For example, during the drought of 1930, there was at Louisville, Cincinnati, Ironton and Portsmouth, widespread complaint concerning objectionable tastes in the municipal supplies of water, in all cases taken from the Ohio river and thoroughly purified to meet the rigorous bacterial standard of safety required by the Federal Treasury Department. At the same time there was an outbreak of gastro-intestinal disturbance. The theory was advanced that the purified water still had a toxic property, resulting from the decomposition of organic substances of vegetable and animal origin which had found their way into the river.

Another similar incident occurred at Detroit, Mich., in 1926. Here the water supply is taken from the Detroit river and subjected to purification processes consisting of coagulation, filtration and chlorination. For a number of hours on February 25, the velocity of flow downstream was reduced greatly, if the direction was not actually reversed. This condition, in conjunction with an unusually large storm discharge from the sewers, permitted the passage of polluting matter across the river to the intake. Apparently, the city's water supply was contaminated to such an extent that it caused some 200,000 cases of intestinal disorder.

These incidents are cited to show that there are still unknown factors entering into the problem of safe and wholesome water supply.

SEWERAGE AND SEWAGE DISPOSAL

In common with the supply of potable water, the removal of excretal

wastes from human habitations is an ancient problem. This is demonstrated by archaeological discoveries made in Asia a few years ago, when the city of Mohenjo-daro was excavated. Situated on the west bank of the Indus river, 1,500 miles from Babylon, Mohenjo-daro is believed to be more than 5,000 years old. The buildings had bathrooms with well-laid floors and latrines occupying recesses in the walls. Vertical pipes led the effluent from the latrines to drains laid underneath the house floors. Water chutes were cut in the outer walls of the houses and a large sewer was laid along the street to carry away the sewage. In the great cities of Babylon and Nineveh extensive sewerage systems are believed to have been constructed about 2000 B.C.

At Rome the Cloaca Maxima, which was constructed between 735 and 510 B.C., was intended to drain a marshy hollow near the centre of the city. Afterwards, by a process of development, it became part of a combined sewerage system for the city. The Cloaca Maxima was one of the largest and most celebrated of the ancient sewers. The solidity of this structure can be judged by the fact that it has been in service for over 2,400 years and is still in use.

From the first century of the Christian era until the nineteenth century, when public water supplies were introduced into great numbers of growing cities and towns, no material progress was made in sewerage. The renaissance began in Hamburg, Germany, where a severe conflagration destroyed part of the city in 1842. The portion ruined was the oldest section and it was decided to rebuild it according to modern ideas of convenience. The sewerage work was intrusted to W. Lindley, an English engineer, who carried it out in a way that aroused warm praise among engineers of a somewhat later period.

As the piping of public water supplies into dwellings became common, the need for prompt and inoffensive removal of liquid wastes became acute. In some cases the need was accentuated by severe outbreaks of water-borne disease. Here again the engineer made an important contribution to the conservation of the public health. In London, England, for example, sewerage works designed by J. W. Bazalgette and W. Haywood were undertaken in 1859, to intercept the sewage from the Thames river along the waterfront and discharge it below the city. This step was taken after two severe cholera outbreaks had devastated the city. As the population tributary to the sewerage system increased, conditions near the outlet became more and more offensive, until in 1890 it was found necessary partially to purify the sewage with chemicals before its discharge.

In some parts of England, sewage treatment had been begun many years before that, the earliest method being that of broad irrigation, or sewage farming. Early in the eighteenth century the sewage of Ashburton was disposed of by using it to irrigate crops. Nearly two centuries later, when the first sewage treatment plant in Canada was put in operation at Berlin, Ontario, in 1893, sewage farming was employed.

The ultimate disposal of sewage received only occasional local attention until the construction of sewerage systems became common. Offensive conditions soon were created by the sewage discharged into British streams, which could not provide adequate dilution. Interference with agricultural and manufacturing uses of water apparently was given more attention at first than possible danger to health.

The work of Louis Pasteur in the middle of the past century was the forerunner of the bacteriological basis of modern sanitation, which was ushered into being with the discovery in 1880 of the bacillus causing typhoid fever. Prior to that year, the relation of pollution to disease had been understood but faintly, as the science of bacteriology was in its infancy and its application to matters of stream pollution and sewage disposal had not been grasped.

The fundamentally bacteriological character of sewage purification was shown in 1882 by Robert Warington, an English chemist, who proved that organic matter was oxidized through the agency of living organisms and proceeded to devise practical methods whereby living organisms could be utilized for oxidizing and purifying the organic matter in sewage. Later, through studies made at the Lawrence Experiment Station of the Massachusetts State Board of Health, under the guiding influence of Hiram F. Mills, the engineer member of the Board, the fundamental biological conditions underlying the oxidation processes of sewage treatment became established.

The complete treatment of sewage nowadays involves both the removal of solid matter by means of sedimentation and the treatment of the liquid portion by oxidation, in order to prevent it from putrefying and causing offensive conditions. One of the oxidation methods of treatment, namely, the passage of sewage through beds of broken stone, believed to perform an important part in the process and called trickling filters, which are inhabited by bacteria, was introduced by Sidney R. Lowcock, an engineer, at Malvern, England, in 1892. Another oxidation method of treatment is the activated-sludge process. This is the outcome of the classic researches carried on by the Massachusetts State Board of Health and has been developed to its present stage of refinement largely though extensive researches carried on in England and the United States. In this method of treatment, sewage is brought into intermittent contact with air and biologically-active solids previously removed from the sewage by the same process. This method is used by Toronto for a portion of the sewage, by many cities and towns in England and on the continent, and by several of the largest cities in the United States.

It is now possible to purify sewage to such a high degree that it is feasible to correct pollution situations which have existed for years, due to the discharge of liquid wastes from growing cities and industries. Moreover, in certain places where water is scarce, sewage is purified to

such a degree that the effluent can be used to supplement the water supplies, under certain conditions.

At Los Angeles, Cal., a plant for studying methods of sewage reclamation has been put in operation. The effluent is discharged upon natural sand beds, through which it is expected finally to reach the infiltration galleries, 1½ miles distant, from which part of the domestic water supply is obtained. The cost of producing an effluent complying with the U.S. Treasury standards for drinking water is said to be less than the cost of water brought in from outside sources.

The sewage and laundry wastes from the resort hotels and camps at Grand Canyon, Ariz., are treated by sedimentation, activated-sludge process, rapid sand filtration and chlorination. The plant effluent is used for generating steam in boilers, for cooling oil engines, for irrigating lawns and for flushing plumbing fixtures. The cost of treatment is $0.57 per 1,000 gallons, including interest and depreciation, as compared with $3.09 for fresh water brought in tank cars from a distance of 100 to 120 miles.

These examples are given, not for the purpose of advocating the reclamation of sewage for public water supplies, but simply to illustrate the high degree of purity which it is now possible to attain by modern methods of treatment.

INSECT CONTROL

The causative agents of certain diseases of warm-blooded animals must complete a part of their life cycles in another animal, generally an insect. In this way, malaria and yellow fever depend upon the presence of certain mosquitoes, typhus fever upon the louse, tropical sleeping sickness upon the tsetse fly, and there are doubtless many other examples.

Since these facts were discovered by medical men, among whom may be mentioned Sir Donald Ross, who showed how malaria is spread by mosquitoes, great strides have been made in the prevention of insect-borne diseases through the control of insects. Such work, especially mosquito control, has become a recognized function of the engineer. The usual procedures, aimed primarily at the breeding grounds, include abatement of small temporary pools of water, ditching and drainage of swamps and marshes, clearing and oiling sluggish streams, and stocking lakes and ponds with larva-eating fish.

The first successful campaign against the yellow-fever mosquito was waged at Havana, Cuba, in 1901. There yellow fever was practically exterminated by the engineering methods of Major William C. Gorgas, a surgeon, ably assisted by Joseph A. LePrince, an engineer. A few years after the Havana campaign, yellow fever was wiped out at Panama by Gorgas, LePrince and others. The conquering of this disease made possible the construction of the Panama Canal, a task which had been found virtually impossible a generation earlier.

REFUSE DISPOSAL

The increasing density of population which accompanied the growth of cities and towns brought with it another engineering problem besides those of water supply and sewage disposal, namely, that of refuse disposal. Municipal refuse consists principally of garbage, rubbish, ashes and street sweepings. When such refuse is left in streets, alleys or yards without removal, it promotes the breeding and growth of mosquitoes, flies, rats and other vermin, all of which tend to spread disease among human beings. During certain seasons, the refuse dries and some of it is ground to dust, which fills the atmosphere, to the annoyance of the people and the probable detriment of their health. Within the past fifty years engineers have devoted gradually increasing attention to the problem of refuse disposal, and much progress has been made in that period.

Garbage, which is more troublesome to store, transport and dispose of than the other kinds of refuse, may be disposed of in a number of ways, including burial in the ground, dumping at sea, feeding to hogs, reduction to grease and fertilizer base, and incineration. The choice of the best method in any given case is an engineering problem.

Disposal of garbage by incineration has become common during recent years. It has been found impracticable to burn municipal garbage without the use of additional fuel. Municipally collected rubbish is the fuel most commonly used. In the British type of incinerator, garbage, rubbish and ashes are burned together.

The first refuse furnaces in Canada were built in Montreal by William Mann in 1885 and 1886. They were intended originally to burn night-soil, but were used also for garbage. In 1906 the first successful mixed-refuse incinerator in America was built at Westmount, Quebec. These plants and many others have aided materially in promoting municipal sanitation.

MISCELLANEOUS FIELDS

In several other fields the engineer contributes toward conservation of the public health. The safeguarding of urban food and milk supplies under modern conditions of transportation calls for the wide utilization of the principles of sanitary science. The relations of air to human health and well-being are receiving an increasing amount of scientific study. Atmospheric pollution, ventilation of buildings, and industrial pollution of the air of working places constitute the principal phases of this subject. It has been suggested that the abnormally high death rate from pneumonia experienced in Pittsburgh, Pa., in the past was related to its rather notorious smokiness, by way of the decreased resistance to infection, known to be associated with a deficiency in vitamins, which in turn results from a lack of sunlight. The importance of smoke abatement in certain cities is therefore evident.

The value of engineering services to public health conservation has been recognized by the establishment of engineering divisions in public health departments. The provincial and state engineers make sanitary surveys of municipalities, assist in epidemiological investigations, advise as to milk control, inspect and advise as to operation of water purification and sewage disposal works and pass upon designs for the installation and extension of waterworks and sewerage systems. The national health engineers exercise supervision of water supplies used for drinking and culinary purposes on common carriers, guard against pollution of inland waters, and make inspections of sanitary conditions on branch lines of railway and other public works under construction. In fact, the engineers in our public health departments have demonstrated the value of engineering advice and guidance to such a degree that they are wielding an important influence in the kind and scope of legislation which is being enacted in the universal endeavour to conserve and promote the public health through control of the environment.

CONCLUSION

The work of the engineer has been concerned, directly and indirectly, with many phases of public health conservation. The engineer's skill has contributed to the development of such health measures as insect control, refuse disposal, food sanitation and air hygiene. But in the conquest of water-borne disease through the improvement of water supplies and sewerage lies the engineer's greatest single contribution to public health.

The future will demand unrelaxed vigilance in the maintenance of health objectives achieved and continued effort for improvement by research and experimentation. What additional health activities will concern the engineer, no man can say. It is safe to predict, however, that with greater complexity of civilized life, new and now unthought of fields of service affecting public health will afford the engineer further opportunities. The engineers appreciate the privilege of working shoulder to shoulder with the doctors, the biologists, the chemists and others in the effort to conserve the public health and to make the world a still better place in which to live.

Municipal Expenditure for Sanitary Works*

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ONE is frequently confronted with the query, "Is the world improving?" This question is propounded, in the main, by pessimists and a few others who are gravely concerned in the evident variation as between the standards of to-day and those established and accepted years ago.

In these times there is a freedom of thought and expression, together with a development of initiative, which somewhat shocks some who have passed the meridian of life.

My conclusion is that notwithstanding the change in the outlook and living of our people, there is a distinct betterment. Individual and corporate life has developed to an extent undreamed of by our forefathers and many of us who have passed the midway of years. Never in the history of mankind has the individual as a unit and governments in representative capacity had such pronounced regard for the promotion of individual and collective welfare.

In no other branch of corporate activities has the change been more marked than in those relating to public health and sanitation. In earlier days, under the guise of personal freedom, the individual was permitted to create and perpetuate conditions inimical to the best interests of himself, his neighbours and the community at large. As a result of education and general enlightenment, he now realizes that his duty and obligation is not only unto himself but unto his neighbour in particular and his fellows in general. We are impressed with the fact that we cannot live unto ourselves alone. Every rightly constituted individual realizes that the protection and well-being of his fellows is a direct personal obligation which must be adequately discharged.

In no branch of public administration has progress been more pronounced than in that of public health and sanitation.

Though their respective functions vary, there is a close inter-relation between the activities of health officers and engineers engaged in or concerned with matters of public administration. Each is complementary to the other and without genuine accord the maximum of benefit cannot be attained.

Administration of public affairs may be broadly classified in three divisions: federal, provincial and municipal. While each is of supreme importance, I respectfully submit that the municipal function is the greatest of the three, inasmuch as it most intimately affects the

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life, health, comfort and well-being of the individual each hour of his life, whether waking or sleeping. In the measure that the duties pertaining to the municipal function are efficiently accomplished, the benefit to the individual is exactly gauged.

We are prone to be thoughtless and take little heed of the unremitting care exercised in furnishing the services essential to our needs. We flush the toilet and the receptacle clears; operate the faucet and water flows; turn the switch of the electric circuit and the filament glows; observe the policeman on his beat, the fire department responding to an alarm, and accept the various bounties of efficient administration as related to public affairs without giving thought to the foresight, skill, planning and continuous application and alertness which provide such services upon demand. When they fail by reason of circumstances which could not have been foreseen or avoided, the tendency is to forget the uninterrupted service of years and execrate the public officer or engineer responsible for continuity of service. This, I grant you, is stimulating to a degree, in that it tends to develop a higher standard of service, but it shows little appreciation of the problems involved. Medical men and engineers, in particular, are expected to be omniscient and unerring and to possess a prescience not given to humans.

The provision of sanitary works requires the expenditure of relatively large sums in small municipalities and of huge outlays in urban centres. The public is entitled to the greatest dollar value return that can be secured for its outlay. The interest which the ratepayer receives for his disbursement is returned to him in the form of added health, security and convenience, plus a monetary appreciation imparted to his holding by reason of the supply and continuity of indispensable services.

A great responsibility devolves upon the members of the engineering profession who are charged with the solution of these problems. I cannot stress too strongly the imperative need for exhaustive preliminary research and the utmost caution in the design and construction of works required for the accomplishment of the purpose.

The public is entitled to protection from the engineer irrespective of personal considerations and should receive a candid expression of his conclusions. Too often have we found in this Dominion that the engineering officer or adviser, whose duty it is to report on and plan sanitary works, has permitted the higher values to be obscured and has been prepared to design and construct installations demanded by uninformed opinion, rather than refuse to execute a commission, the consummation of which is doomed to failure, with the result that stigma, dissatisfaction and waste of public funds ensued.

Happily, in this province of Ontario, we are favoured with public health laws which require that all such projects be submitted to the very efficient Engineering Section of the Department of Health, whose

approval is a prerequisite to construction. While this is a distinct safeguard, it does not relieve the municipal engineer or adviser of a bounden duty to furnish his clients with what they should have rather than that which they desire.

It is far better to abandon proposals than to court the hazard of pursuing unsound or unproved practice, or of installing inadequate works.

The public generally fail to realize that the solution of a sanitary problem is peculiar to the individual municipality. There is a widespread misconception that if certain systems or devices operate satisfactorily in one locality, a duplication should produce the same result in another where the characteristics may be quite different. This viewpoint is rather difficult to combat effectively, with the result that considerable difficulty is at times experienced in procuring a prompt appropriation for the proper analysis of sanitary problems.

I think it may be safely stated that, with very few exceptions, it is not possible to secure a public water supply that may be distributed to consumers with safety unless it be filtered, chlorinated, or subjected to both treatments. This is particularly true in the case of cities contiguous to the Great Lakes, where the question of treatment and disposal of sewage is all-important.

The treatment and disposal of sewage have not developed so rapidly and on as sure a basis as has water purification. Municipal officers have rightly hesitated to make recommendation for large expenditures for sewage treatment works, owing to the comparatively rapid changes which have taken place, with the consequent threat of obsolescence. Indeed, some municipal officials have, during the past fifteen years, found it somewhat difficult to restrain their principals from embarking upon great expenditures for sewage treatment by processes which, in the light of present-day knowledge, would have fallen far short of accomplishing results that may be obtained under present practice. Happily, sewage treatment and disposal are now on such an assured basis that municipal officers may, with confidence, recommend the necessary expenditures on systems which exhaustive expert investigation and analysis show to be adaptable to their particular needs.

The city of Toronto, in the year 1910, after receiving expert advice from Dr. John Watson, a noted English authority, and Dr. Rudolph Hering of New York City, constructed twenty-four Dortmund sedimentation tanks with separate sludge digestion open lagoons on the shore of Ashbridge's Bay at a cost, including main interceptors, of approximately $2,500,000, of which $694,029 represented the actual outlay on the treatment plant and works. This involved the acquisition of a treatment plant site having an area of 48 acres, of which 27 constituted land, 21 land covered by water. This plant was placed in operation in March, 1913, and treats the sewage flow from the whole of

the city, exclusive of North Toronto, to which I shall make later reference.

In the early years of operation, considerable complaint was received by reason of the emanation of odour from the sludge digestion lagoons, but of recent years this has been almost wholly overcome. Digested sludge is pumped from the lagoons in the spring and fall to an area of the bay protected by a dyke, and an appreciable land area has been thus created. The effluent from the plant is discharged into the waters of the lake by way of an outfall. Ashbridge's Bay has but one opening to the lake. It was found that the sluggish waters of the bay were contaminated by seepage, etc., from the piled lagoons, whereupon the corporation installed a pumping plant which operates continuously and discharges into the bay sufficient water to displace its liquid contents at least once daily.

While the question of sewage treatment was receiving consid eration, the city realized that water filtration, with subsequent chlorination, was indispensable to a potable supply, whereupon a slow sand filter plant was constructed on Toronto Island at an outlay of $570,767. This plant had a rated capacity of 48 million gallons a day and filtered at the rate of 4.16 million gallons per acre. It was placed in operation in January, 1912. Increasing requirements demanded additional filter capacity. In July, 1918, a plant of the drifting sand mechanical type was placed in operation with a rated capacity of 60 million gallons,and a filtration rate of 125 million gallons per acre. The outlay on this latter account was $1,077,690.

As those of you concerned with water treatment will recollect, great difficulty was experienced in controlling taste during the earlier days of chlorination, owing, mainly, to crude methods of application. This feature was overcome by the introduction of liquid chlorine, the development of accurate and refined control apparatus, and rigid laboratory and mechanical supervision. This, however, did not entirely obviate cause for complaint. At times, the rate of contamination of the raw water changes rapidly; phenols are contributed by industrial waste and the presence of an unidentified vegetable organism makes itself manifest. These, in combination with chlorine, imparted an offensive taste to the filtered product which has been successfully overcome by dechlorination with sulphur dioxide.

Toronto, with a population of approximately 650,000, draws its water supply from Lake Ontario, to the south of Toronto Island. In 1912, the writer was seized of the danger of a large city being dependent on a single source of supply which, in the event of failure, would leave the citizens without water. After extensive investigation, I recommended the construction of a duplicate intake, pumping and filtration system to be located on the lake front immediately to the east of the eastern city limit. It was estimated that the installation could be made, at that time, for approximately $6,677,000. The site and ex-

penditure were approved by the ratepayers. In 1914, the war intervened and, of necessity, the project was deferred. After repeated efforts, the question was again submitted to the ratepayers who, on January 1st, 1925, approved an expenditure of $14,500,000 for the project. Construction is under way and we hope to complete it within the ensuing three-year period. The plant, as it is to be installed, with provision for future extension of the intake, filter and pumping units, will suffice for the ultimate needs of Toronto and its environs, with an adequate reserve.

In 1912, the City annexed the town of North Toronto, having an area of 2,701 acres and a population of 6,889. The water supply, derived from a local source, was insufficient and a large sum has been expended in the interval to furnish a requisite supply. The town had installed a sewerage system, with three small disposal plants, all of which were inadequate. There was a large territory of unoccupied land which offered possibilities for residential and retail business development. A sewerage system has since been installed by the City on the local improvement plan at a cost of $8,239,481, of which the Corporation at large bore 55.98 per cent, and the local ratepayers 44.02 per cent. The trunks and outlets have a total mileage of 15.3, while the local sewers have a mileage of 67.6, a total of 82.9 miles in all. The proportion paid by the City is higher than usual, owing to the dimensions of the trunks and the fact that a very costly outlet was constructed through the adjoining municipality of Leaside, outside the limits of the City.

Consultants were engaged to advise relative to sewage treatment and disposal for the area known as North Toronto, as a result of which the municipality in 1927 secured 109 acres of comparatively isolated valley land at an outlay of $139,269, lying partly within the Town of Leaside and partly within the Township of East York, whereupon a treatment and disposal plant of the activated sludge type was erected at a cost of $885,986. This plant was designed to serve 50,000 people. It was estimated that the district would have such a population in the year 1935. However, development has taken place so rapidly that this population was attained in 1931 and plans are now being prepared for a plant addition at an estimated cost of $800,000.

By arrangement, the Corporation treats, at the North Toronto plant, the sewage flow from the adjoining municipalities of Leaside and Forest Hill. The effluent from the works is discharged into the river Don.

As indicated, development in recent years in the treatment and disposal of sewage has reached such a standard that municipalities are now justified in making large expenditures for such facilities, with the assurance of receiving adequate service for the outlay made.

The City of Toronto is now confronted with the problem of furnishing a modern sewage treatment and disposal plant for the whole

of the city (exclusive of North Toronto), to replace the main sewage disposal works described previously. It is probable that a disbursement of upwards of twenty million dollars will be required for this purpose. Consulting engineers are now studying the problem. When this expenditure is made, it is estimated that it will be the largest amount ever disbursed by the Corporation on a single project.

In the year 1928, the Government of Ontario, at the instance of the Department of Health for the Province, enacted legislation which is destined to accelerate measurably the solution of sanitary problems in the larger urban centres. This legislation provides that cities having a population of not less than 100,000 may, with the approval of the Ontario Railway and Municipal Board, provide by by-law, without the approval of the electors, for the issue of debentures for the purpose of raising money to procure investigations and reports as to the method of sewage treatment and disposal best suited to meet the needs of the municipality. It is further provided that, instead of making a separate issue of debentures to defray the expenses of such investigation and report, the Council may provide that such expenses shall be included in the cost of the work and be paid out of the proceeds of any debentures issued therefor. Thus the considerable outlay requisite for proper and searching investigation and report by those best qualified need not be levied with the current expenditures for the year but may be held in suspense and charged to the capital outlay for the cost of the work, where it rightly belongs.

In the municipality of Toronto, local sewers and sewerage systems are provided under the local improvement plan, while relief sewers and sewage treatment and disposal works are financed at the expense of the city at large.

Refuse Collection in Urban Centres*

H. S. NICKLIN

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Introduction

AT the present time, refuse collection and disposal is a municipal problem of major importance in sanitary engineering. Our mode of life under modern civilization tends to promote the accumulation of large amounts of refuse which eventually has to be collected and disposed of. It is a serious problem because it affects not only the community's health but the community's pocket book, and it therefore has to be carefully studied from both these angles.

In this paper it is proposed to deal almost entirely with the collection of refuse. Collection of the refuse is, of course, the first step in the project. The method of collection will vary greatly in different cities, depending upon local conditions and the means of disposal. Methods of collection also tend to change to some extent, due to changing conditions. The successful method of collection in one city is not necessarily successful in a neighbouring municipality. The most successful and economical collection for a large city may not work out so well for a smaller centre, and likewise the most suitable method of collection where the refuse is incinerated may not work so well where disposal is by the fill and cover method.

The amount of refuse to be handled varies in different cities according to local conditions. Some of these conditions might be noted as follows:—Type of fuel used for heating and cooking; type of furnace used and whether coal, coke, wood, electricity or gas is used; the number of houses connected to sewerage systems; whether vegetables are used mostly in their natural state or from cans. Grass cuttings and garden refuse help to swell the tonnage of refuse collection.

Especially under present economic conditions the element of cost is very important, but it is safe to say that service rather than cost should be the most important consideration. Too much emphasis should not be placed on attaining the low collection costs of another centre. Local conditions may easily account for the apparent difference. The difference in cost per capita between an efficient system of collection and an inefficient one will be small. Therefore, again let it be emphasized that service rather than cost should be the first consideration. From the standpoint of public health it is necessary to take this attitude.

The development of methods for the collection and disposal of municipal refuse has been slow but progressive. In the early days the

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care of such materials was left to the individual, who was advised to burn the combustible parts, and to deposit the non-combustible on low areas or at points sufficiently remote to avoid any objection. When garbage or other material of any food value was deposited outdoors, it was picked over and largely removed by birds and wandering animals. This practice sufficed where the population was not congested, and the accumulation did not become extensive.

Refuse collection and disposal is related to sewerage, but does not involve anything like the large capital expenditure as required for the latter. Little attention is usually given to this question until water and sewerage facilities have been established and the population has reached a sufficient size to carry conveniently the extra financial burden entailed.

2. REFUSE

(a) Classification.

Municipal refuse materials are the solid waste matters resulting from the natural activities of a community. They are distinct from the liquid portions of the community wastes—generally called sewage. The general term "municipal refuse" includes the following classes of waste material:—

(1) Public refuse—The rejected material collected from streets and lanes.
(2) Trade refuse—The solid wastes from slaughter houses, factories, and various business establishments.
(3) Market refuse—That resulting from the operation of commission houses and public markets.
(4) Stable refuse—Composed chiefly of manure and straw from stables.
(5) House refuse—Wastes from houses, apartments, stores, schools, churches, hostels, etc. It is composed of garbage, ashes, rubbish, and night soil.

DISPOSAL

General Method

It is not proposed to deal with the various methods of disposal at any length. They have been already mentioned. The type of disposal may govern to a large extent the method of collection. The final method of disposal must satisfy two important requirements.

1. It must be sanitary.
2. It should be as economical as possible, consistent with sanitary results.

The choice of any particular one of these methods is usually made with regard to the particular condition existing in the municipality. The small town is of necessity more interested in those methods which require only a small financial expenditure. Other municipalities may choose incineration with a view to procuring most sanitary results with the minimum of trouble and with a possibility of utilizing the heat produced by the process.

4. METHOD OF FINANCING

Section 406, Chapter 233, of the Municipal Act is as follows:

"By-laws may be passed by the Councils of cities and towns:

Garbage Collection

1. For establishing and maintaining a system for the collection, removal and disposal at the expense of the corporation of garbage or of garbage and other refuse or of ashes, garbage and other refuse and with the approval of the Department of Health for erecting and maintaining such buildings, machinery and plant as may be deemed necessary for that purpose, or for contracting with some person for the collection, removal and disposal by him of the ashes, garbage and other refuse upon such terms and conditions and subject to such regulations as may be deemed expedient.

(*a*) Where the amount required for the erection of such buildings, machinery and plant and for acquiring the requisite land exceeds $5,000, the by-law shall not be finally passed without the assent of the electors entitled to vote on money by-laws.

2. For the collection, removal and disposal by the corporation of garbage or of garbage and other refuse or of ashes, garbage and other refuse throughout the whole municipality or in defined areas of it at the expense of the owners and occupants of the land therein, and for imposing upon such land according to its assessed value a special rate to defray the expense of such collection, removal and disposal.

(*a*) Subject to clause (*c*) no land shall be exempt from the special rate, anything in any general or special Act or in any by-law to the contrary notwithstanding.

(*b*) The special rate may be collected or recovered in the manner provided by section 512,—

"Where a council has authority to direct or require by by-law or otherwise that any matter or thing be done, the council may by the same or by another by-law direct that in default of its being done by the person directed, or required to do it, such matter or thing shall be done at his expense, and the corporation may recover the expense incurred in doing it by action, or the same may be recovered in like manner as municipal taxes, or the council may provide that the expense incurred by it, with interest, shall be payable by such person in annual instalments not exceeding ten years and may, without obtaining the assent of the electors, borrow money to cover such expense by the issue of debentures of the corporation payable in not more than ten years."

The first step would be to define definitely the garbage area. It would be necessary to determine the methods of disposal, whether by incineration, or other method. The method and details of collection would be determined. From the above factors the estimated annual cost would be arrived at.

In Section 415, Subsection 5, the powers of Township Councils are defined as follows:

By-laws may be passed by the Councils of Townships for exercising the powers conferred on cities and towns by paragraph 2 of section 406, with reference to the collection, removal and disposal by the Corporation of ashes, garbage, and other refuse.

In the same manner Section 416, Section 2, gives the authority to Councils of Villages as set out in subsections 1 and 2 of section 406 for towns and cities.

The question of financing the purchase of new equipment for collection of refuse and for the construction of an incinerator if required is covered by Section 296, subsection 2 (*b*). This reads as follows:

"The whole debt and the debentures to be issued therefor shall be made payable within the respective periods hereinafter mentioned at furthest from the time when the debentures are issued.

(*b*) If the debt is for the establishment of a system of public scavenging, or for the collection and disposal of ashes, refuse and garbage, in ten years."

Once the estimated cost of collection and disposal of refuse has been calculated, it is then an easy matter to determine a definite mill rate to be charged on the assessable property within the garbage area.

The matter of collecting the charges against property for refuse collection and disposal by levying a fixed mill rate is general and prob-

ably the best method. The same office machinery which collects the general taxes will collect the garbage levy.

Outside this garbage area there is no universal method adopted for removing refuse. Many citizens will arrange for the garbage collector, if done by contract, to remove their individual refuse at an agreed price. Other citizens will arrange to burn or remove their own. In any event, citizens living outside the garbage area in general will pay more for the same privilege, or else will not receive the same service.

5. COLLECTION

The collection of refuse is an intermediate stage between house treatment and final disposal, and an intimate relation exists among all three. The organization of the collection service must satisfy the popular needs. The special requirements of the various classes of people living under different conditions must all be considered as well as the influence of the season. The frequency of collection and the efficiency with which it is carried out are of more concern to the householder than is the method of ultimate disposal. This is because the entire municipality comes in contact with the collection service and defects are consequently felt over a large area, whereas the disposal process may affect only those adjacent to the works.

The conveying of refuse from the points of origin to those of final disposal may quite properly be divided into two parts. One pertains to the primary collection or gathering of the material from the houses into the wagons or trucks, and the hauling of it to defined points for subsequent transportation, or, as in small communities, direct to the places of final disposal; the other part pertains to transportation of the refuse by secondary means after the original collection. Such methods may include transportation by barges, motor trucks, street railways, or railroad cars, the necessity for which increases with the extension in area of the community served.

(*a*) *Methods of Collection*

A variety of methods and equipment for collecting refuse are found. Many types of wagons are in use and their capacities range from 1.5 to 4.0 cu. yards. Some are covered and others are open. Trucks may have a capacity from 2 cu. yds. to 5 cu. yds. or more. The interval between collections varies from daily to once a week or even longer for ashes and rubbish. In some cases the collection is done at night, and the householder sets out his can in the early evening. Two main requirements, no odour and no dust, must control the collection of refuse, regardless of which of these methods are in operation.

(*b*) *Frequency of Collection*

The time interval between collections should be sufficiently short to prevent any nuisance from storage. Garbage which is kept separate must be collected more frequently than either rubbish or ashes because

of its putrescible nature. This interval should, in addition to eliminating any nuisance, satisfy the householder and give opportunity for approximately one full can of refuse to accumulate under average conditions.

In the larger cities, and especially in the more thickly populated sections, it is customary to make collections daily. This is not only advantageous for sanitation, but very often the method of final disposal, especially hog-feeding, requires that the garbage be fresh. In all cases there should be a daily collection for hotels, restaurants, and boarding houses, where there is a large accumulation of organic wastes. Garbage not mixed with other refuse should be collected from all residences at least three times per week. More frequent collections beome necessary in summer than in winter. Ashes need be removed only often enough to prevent undue accumulations, while rubbish should be collected at least every two weeks, or there will be tendency to untidy premises. Mixed refuse does not require as frequent collection as garbage, but to be satisfactory it should be made regularly at least twice a week in summer from residences and daily from hotels, restaurants and boarding houses. In winter, especially in the colder climates, the collections may be reduced to once a week for residences.

(*c*) *Private or Municipal Collection*

Especially in the larger cities it is preferable to have a special department for refuse collection. In this way there is more direct supervision over the work. In smaller municipalities, however, collection by contract may work out very satisfactorily. It can work well by contract only if definite specifications are drawn up and enforced. It is very important in letting contracts of this kind to insist on the contract going to a responsible contractor. In many cases the contractor submitting the lowest tender cannot carry out the conditions of the contract and eventually it has to be taken out of his hands.

(*d*) *Combined or Separate Systems*

There are two general systems or methods of collecting refuse in American municipalities, (1) the combined system, and (2) the separate system. The former is one by which all classes of refuse are stored together in the one receptacle and collected in the one wagon. The latter requires different classes of refuse each to be kept in individual containers and collected separately. The adoption of the combined or separate system will, like the house-treatment, be governed by the selection of the method of final disposal.

6. EQUIPMENT

The size of wagons and trucks for collection is one of the most important features. The most suitable capacity can best be determined after a careful study of local conditions. The working time of

a collector may be divided into two parts, namely, the productive time, *i.e.*, the time spent in loading; and the unproductive time, or that spent in driving the loaded wagon from the last point of collection to the point of transfer or final disposal. The size of the wagon should be such that this unproductive time will be a minimum. For short hauls the size of wagon is relatively unimportant, but when it extends to a number of miles, the size should be carefully considered. If trucks are used, the length of haul is not so important a consideration.

The following capacities are commonly used in practice:

For garbage	3 to 4 cu. yds.
For ashes and rubbish	5 "
For mixed refuse	5 "

The loading height of a wagon should be convenient for the workman. The top edge should be not more than six feet, and preferably not more than five feet from the ground. Where stepboards are used, a somewhat higher wagon may be loaded without difficulty.

(*a*) *Covering*

All refuse requires covering during transportation. Ashes and rubbish must be covered to prevent dust and loose papers from being blown about, while garbage should be protected from flies and screened from view. If flies are permitted to gain access to the garbage, they follow the wagons and spread over the community. Wagons used in some localities are provided with a hinged cover or lid. Difficulties are experienced with this type, however, in keeping pieces of refuse away from the lid, and in preventing garbage juices from adhering to the hinges and frames. The covering most commonly used at present is canvas or tarpaulins. These are quite satisfactory and enable the wagon to be piled high without interference of the top. They should be washed frequently.

(*b*) *Dumping*

Loaded wagons must be dumped as quickly and as conveniently as possible. Bottom dumping wagons are more serviceable where the refuse is placed on dumps, but they are more difficult to keep watertight than others. Dumping at the rear by raising the forward end is particularly suitable where carts are used.

(*c*) *Horses vs. Motor for Primary Collection*

The large number of stops required in the primary collection of refuse has fairly well removed this in the past from the field of the motor vehicle, except where more than one collector goes with each vehicle, and the length of stops is decreased. Lengthy hauls to disposal or transfer points may affect the use of motors in primary collection; but for average conditions, the horse, either with cart or wagon and team, is still most extensively used. Motor trucks, specially designed for refuse collection, are, however, coming into more general use at the present time.

(e) Supplemental Transportation

In small municipalities supplementary transportation is seldom required. In larger communities, however, too much time would be lost by the slow-moving collecting vehicles. As municipalities grow, central sites for disposal works become scarce and hauls are increased. Where the material is fed to hogs or reduction is used, there is little opportunity for utilizing several disposal plants centrally located in the one municipality. Greater transportation distances thus become necessary.

Under these conditions the common practice is to have the garbage collected in horse-drawn wagons or carts and brought to a relay, transfer, or loading station. Here it is generally handled by motor truck or tractor. Motor trucks may not be able to go on garbage fills in the spring of the year. For example, in Guelph with the trenching and filling system it would probably be impossible for motor trucks to proceed to the necessary location. A tractor would undoubtedly solve this trouble.

(f) Cost of Equipment

Cost of equipment varies, depending upon the size and special requirements. Wagons and motor trucks, especially the latter, are usually built, more or less, to a custom design calculated to meet special conditions in some particular municipality.

The following are approximate prices on motor truck equipment:

1½ ton truck, 2 yard body, hydraulic hoist, approximate price	$1,500.00 to $2,500.00
2 ton truck, 2½ yard, hydraulic hoist, approximate price	1,800.00 to 3,000.00
3 yard truck, straight dump body	Up to $4,000.00
Heavy duty truck, 5 yard capacity, garbage body, hydraulic hoist—approximate price	$4,000.00 to $5,000.00

The City of Hamilton recently made a very exhaustive survey into the question of equipment and finally purchased trucks, capacity 5 cu. yds. water level, including cab body and special hydraulic hoist, the equipment complete costing $3,846.50. These trucks can carry a much larger quantity of refuse than five cubic yards, as the refuse can be heaped up to a surprising degree.

As an example of cost of special equipment I might say that an order was recently placed by the City of New York with one firm for 774 trucks, each having a body of net volume of 8 cu. yds., entirely built of steel, for hauling refuse or snow, built to special specifications at an approximate price of $9,000.00 each.

Garbage trailers of the reversible type suitable for use with motor truck or tractor can be purchased as follows:

3 yard, level full trailer at approximately	$1,800.00
4½ yd. level full trailer at approximately	2,200.00

The above are all metal, watertight vehicles.

Steel garbage bodies suitable for the lighter model trucks can be purchased for the following approximate price, including hydraulic hoist:

2 yard capacity	$350.00
3 yard capacity	375.00

Wagons constructed by the Department of Street Cleaning in Toronto in their own shops and designed to carry one ton of garbage when fully loaded, cost approximately $300.00 each.

New single dump wagon, capacity 1½ cu. yds. ashes or 2 cu. yds. refuse, can be purchased for approximately $100.00.

New double pump wagons, capacity 3 cu. yds. or 4 cu. yds. heaped up, can be purchased for approximately $375.00.

At this point, mention might be made of one feature which is very important. If the refuse collection is by contract, the period of con-

tract is usually not great. Assume it is for a three-year period. Naturally the contractor hesitates to invest in the latest or more expensive equipment since at the end of his comparatively short contract he may have this on his hands at a monetary loss. On the other hand, a municipality, collecting its own refuse, can purchase first-class modern equipment even though apparently expensive, knowing that over a period of years it is really the cheapest. This is due to lower maintenance costs and also increased efficiency, and tends toward decreased costs of collection.

TYPICAL CASE

Let us now consider the case of a town of 5,000 people where there is no municipal system of refuse collection.

Assume the town to have an area of 800 acres and that there are 1200 houses.

Assume also one collection per week from residences or a total of 1200 collections per week and daily collections from hotels, restaurants, etc.

For this particular case, horse-drawn units will probably be most economical. Assume a system of disposal by dumps.

Assume an average of five collecting days per week and that the equipment consists of two single dump wagons, also that one wagon collects from 150 houses per day or 750 per week and that the other wagon collects from 450 houses in three days. This will give two days' extra time to the second wagon or sufficient time for the second wagon to make daily collections from restaurants, hotels, etc.

If the total assessment figure is placed at $2,000,000.00, which may be called an average assessment, and the garbage levy is placed at 1½ mills, then we will raise for refuse collection and disposal the sum of $3,000.00. The average cost per residence for both collection and disposal will be $2.50, which figure is somewhat higher than the average cost per residence for the municipalities of Ontario, but the average cost per capita is $0.60, which is the average cost per capita for these municipalities.

If hired by contract, single dump wagons (driver included) can be hired for 60c. per hour, or $48.00 per week for the two outfits on the basis of an eight-hour day and a five-day week. This makes a yearly cost of $2,496.00. Assume the cost of spreading, covering, etc., at $504.00, then total yearly cost is $3,000.00.

The above example of the use of single wagons will work successfully and economically only if the haul to the dumping ground is short. On larger hauls double wagons would be necessary and in this latter case probably the working time could be cut down in order to keep within the allowable expenditure.

Conditions vary in every municipality and each case has to be worked out according to local conditions.

The Progressive Fight against Typhoid Fever in Canada during the Past Twenty Years*

With Special Reference to the Controlling Factors

NORMAN J. HOWARD

Director, Filtration Plant Laboratories, Department of Public Health, Toronto

ONE of the most outstanding examples of the remarkable progress made by preventive medicine and sanitation in Canada during the past twenty years, is the success in the fight for the reduction of typhoid fever and other gastro-intestinal diseases, chiefly associated with impure or grossly polluted water or milk supplies. The picture which can be portrayed is almost romantic in character, because at the beginning of this decade water-borne disease was of common occurrence. Epidemics were frequent; the typhoid fever case and mortality rates were high; the infantile death rate due to diarrhoea was excessive; and generally speaking, the vital resistance of the community against other infectious diseases, as a result, was probably lowered. With the treatment and purification of public water supplies which has steadily increased in the Dominion since 1911, we find that where effective treatment is employed, water-borne disease is non-existant. Typhoid fever in most of the provinces has been reduced to almost endemic rates; the type of infantile diarrhoea normally associated with impure water has been largely reduced; and, finally, where a pure water supply has been provided, marked improvement in general sanitation has usually followed, resulting in greatly improved health conditions throughout the community involved.

The late Professor G. C. Whipple, possibly the outstanding vital statistician of his time, computed that each typhoid death cost the community $10,000, including the cost of non-fatal cases. As an example of what this means, if we refer to the Toronto death rate of 1910, when the figure was 40.8 per 100,000 of population (1910 population, 341,991), and compute the loss on the Whipple formula, we find that, due to typhoid fever alone, an amount of $1,395,000 was lost to the city in that year. Had this mortality rate continued and the population increased proportionately, the loss to date would have run into millions of dollars. The present picture shows that in 1931, with a population of approximately double that of 1910, the Toronto typhoid fever death rate has been lowered to 0.5 per 100,000: truly a wonderful and humanitarian achievement.

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In considering the question of the incidence of typhoid fever, it is necessary to outline briefly the causation. The chief agencies through which the disease is transmitted are water, milk, carriers, uncooked vegetables and other foods, shellfish and flies. Other sources include ice, bathing in polluted water and the excretions of birds contaminating water in open standpipes and reservoirs. The last-mentioned source of infection was reported upon in England by B. A. Adams, who claimed to have recovered *B. typhosus* from the droppings of gulls. We must assume that the chief cause of the disease is impure water and milk. The part played by water is indisputable, while the periodic epidemics of milk-borne typhoid, invariably serious in character, suggest that radical legislative steps are necessary to prevent the possibility of this deplorable and preventable cause. In the past, and possibly to a lesser degree at the present time, carriers of the disease play an important part. But for this, the endemic rate existing in many parts of the country might be considerably lower. The number of cases due to shellfish, uncooked food and vegetables, flies and other causes is probably small. Each year more stringent regulations are being enacted to sterilize and control the pollution of water in the vicinity of shellfish beds; greater care is exercised in fertilizing the soil in which green vegetables are grown; and, as result of education and publicity, the average consumer is more careful to cleanse raw vegetables before consumption. The fly menace is much overrated, although there is no question that the hazard exists. With improved sanitation it will in time doubtless be reduced to a minimum. There is, however, a questionable tendency to blame flies for infections the causes of which are sometimes obscure.

In considering impure water as a source of contagion, we have certain clearly defined causes, which include (1) the ingestion of impure and untreated water, including surface and ground supplies, (2) water treated but insufficiently sterilized, and (3) accidental pollution occurring under a variety of conditions. In the first classification, untreated surface and ground water supplies are potentially dangerous unless their bacteriological purity has been established. In the second grouping, insufficiently purified waters include all polluted supplies which may have been treated or filtered, but which, due to indifference or neglect, have not been completely sterilized. The third class probably involves the greatest source of danger. Experience has shown that the largest number of epidemics have been caused by either accidental pollution or indifference on the part of officials to take notice of warnings given them regarding the source of their supply. It is not the object of this paper to enlarge further upon this, as the literature covers the subject fully. It is important, however, to outline clearly the hazards which exist and to state emphatically that the majority of water-borne epidemics reported in the past were preventable and should never have occurred. Sir Alexander Houston, the internation-

ally known expert, pointed out that "the current desire to cut the typhoid fever death rate in two should not lead waterworks authorities to assume without sufficient warrant that the danger of epidemics has been wholly removed by improved processes of purification, or to forget the vital distinction between specific and non-specific pollution, and the enormous importance of guarding against the possibility of accident." In the case of milk-borne epidemics, a majority have been caused by carelessness or by carrier infection. For this there is no excuse. The act of allowing a carrier to handle milk or utensils in a dairy plant is criminal in character and calls for no further comment at this stage.

TABLE A

DEATH RATES PER 100,000 POPULATION FROM TYPHOID FEVER IN CANADA BY PROVINCES, 1921-30

Year	Canada	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
1921	10.1	10.1	6.1	14.4	16.2	7.3	7.0	8.3	10.5	4.0
1922	8.4	3.4	4.0	11.6	13.6	6.0	5.4	9.1	9.1	2.6
1923	9.0	8.0	4.6	15.7	13.5	7.9	4.8	8.2	7.4	2.2
1924	6.6	5.8	5.2	11.8	12.7	3.6	3.5	4.7	4.4	2.6
1925	5.9	15.1	3.7	10.2	9.3	4.4	3.6	4.8	4.5	2.2
1926	4.9	8.0	3.3	4.8	9.8	2.4	4.2	3.7	3.0	2.5
1927	11.6	4.6	2.5	8.8	32.7	3.4	4.1	2.5	3.3	2.1
1928	4.8	5.7	5.2	4.7	9.6	2.4	3.2	2.4	4.0	1.6
1929	4.7	5.7	2.3	6.2	8.7	2.9	4.1	2.6	3.9	1.5
1930	4.4	8.0	2.5	4.9	9.1	2.3	1.7	3.2	2.4	2.5

TABLE B

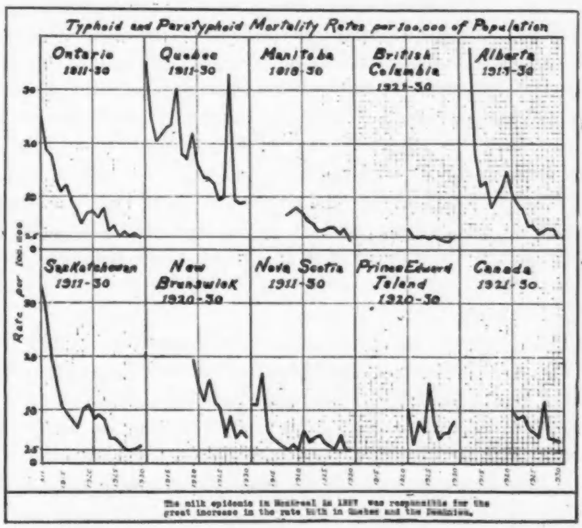
CASE RATES PER 100,000 POPULATION FROM TYPHOID FEVER IN CANADA BY PROVINCES, 1924-30

Year	Canada	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
1924	(1) 24.4	(1)	21.7	51.4	30.4	27.8	13.0	10.0	16.1	9.1
1925	(1) 21.4	(1)	8.7	45.0	18.2	27.5	15.5	15.5	20.6	16.2
1926	(1) 19.4	(1)	10.5	27.3	21.9	18.4	20.0	26.3	20.6	8.1
1927	(1) 84.2	(1)	14.0	114.8	240.3	27.1	17.4	10.8	11.1	7.4
1928	(1) 22.9	(1)	23.7	37.9	32.2	21.8	12.0	9.4	18.4	15.8
1929	(1) 18.7	(1)	6.0	34.4	21.9	22.3	16.0	6.7	17.7	9.9
1930	22.1	13.6	7.0	43.1	33.6	19.7	13.4	10.9	9.6	22.9

(1)Cases for P.E.I. not available.

For the purpose of briefly analyzing the typhoid statistics available, we must first assume that a few years ago typhoid fever was a common complaint in all the provinces, with the exception of British Columbia and, to a lesser degree, Manitoba. With this picture in mind, we are struck with one outstanding fact; namely, that in British Columbia, with the use of virgin water obtained from remote sources free from pollution, the mortality rate for typhoid fever has not exceeded 2.5 per 100,000 since 1922. In the previous year the rate was 4.0. Similarly

in Manitoba notably low figures have prevailed in the same period. In British Columbia not a single treatment plant exists, while in Manitoba, out of 11 purification works, 7 supplies are sterilized. On the other hand, in all provinces using water subject to continuous or occasional pollution, varying typhoid rates have prevailed. Here is presented a clean-cut picture of one of the predominating causes. The reason for the higher than normal rates in New Brunswick and Prince Edward Island is uncertain, but inasmuch as the rates in Saskatchewan and Alberta have been brought under control in the past five years, there would seem to be no logical reason why the figures for the other two provinces should not be considerably lowered. The condition in Nova



TYPHOID AND PARATYPHOID MORTALITY RATES PER 100,000 OF POPULATION IN CERTAIN PROVINCES OF CANADA.

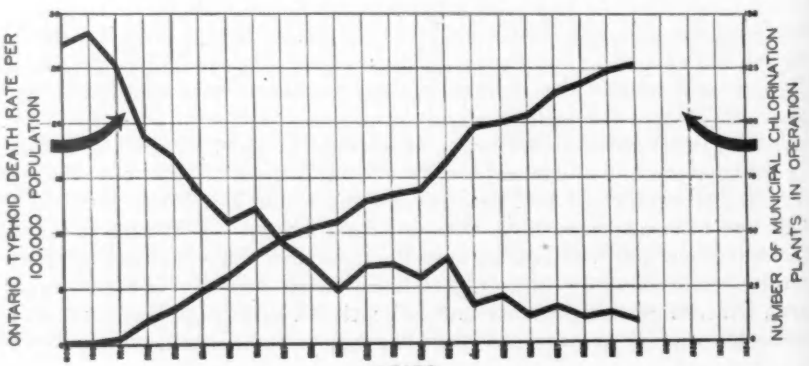
Scotia is not altogether satisfactory as judged by the periodic rise in the curve, indicating a condition regarded as controllable. The figures for Quebec still remain the highest in the Dominion, but, apart from the year 1927 when the milk epidemic scourged the city of Montreal, the rate has progressively declined. In facing the most difficult situation in the country, the officials of the Provincial Bureau of Health—notably Mr. T. J. Lafrenière, Chief Sanitary Engineer, and Mr. McH. McCrady, Chief of Laboratories—have done outstanding work. We find that in Quebec some 550 waterworks systems exist and that 64 municipalities receive treated water and only 40 chlorinated water. The enormous area covered by this province and its scattered rural population present difficulties which require a deal of courage to handle and control. In

the annual provincial report for 1929-30, the following comment by Mr. Lafrenière is noted:

"The improvement effected in the quality of the drinking water has had a marked influence on the typhoid fever death rate. Previous to 1910, or before the beginning of water purification in this province, the average rate from typhoid fever was 30 per 100,000 population; it has fallen to 8.9, the rate for 1929. Further, this disease, which is usually a disease of urban centres, is now more frequently encountered in rural areas since the cities and towns have improved their water supplies. In 1929, the death rate from typhoid fever in the urban centres was 4.7 as compared with the rate of 11.4 in the rural areas. . . . . . The mortality from typhoid in the 40 municipalities previously served with chlorinated river water only, was 39 per 100,000 population previous to 1910. From 1910 to 1919, 9 installations were made and the average rate for this period was lowered to 31.1. From 1920 to 1929, 25 other installations were added and the rate fell to 16.5. For the year 1929, the rate was 16.1. It would be still lower if several municipalities exercised greater care in the operation of these plants. . . . . . . Our death rate is still higher than that of several of the other provinces of the Dominion better provided than we with respect to underground water supplies, and it is becoming increasingly more difficult to obtain the improvements required, since it is now the smaller municipalities which need water purification and their financial resources are necessarily limited."

Possibly the greatest advance in the treatment of water was made in Ontario, where the typhoid mortality rate was lowered from 26 per 100,000 in 1911 to 2.2 in 1930. We find that in 316 waterworks systems under the control of the province, forty per cent of the water is filtered and eighty per cent of all water consumed is chlorinated. What has been done in this province must in time be duplicated elsewhere in Canada.

WATER CHLORINATION AND TYPHOID MORTALITY IN ONTARIO



The Dominion rate, as a whole, showed a marked and progressive decline from 1921 to 1930, these being the only years for which the figures are available. In considering this statement, allowance must be made for the rise in the rate for 1927, due to the milk epidemic in Montreal. It will be seen that in 1928 the decline noted in 1926 continued, and reached a new low figure of 4.2 in 1930. As judged by the prevailing provincial rates, it is difficult to see how the Dominion rate can be materially lowered until at least four provinces bring their rates down appreciably.

TABLE C

PROVINCIAL WATER WORKS DATA

Province	Water Works Systems	Purification Works	Chlorination Plants	Water-borne Epidemics
Ontario	316	63	162	(1911-30) 45
Quebec	550	*54	*36	(1920-29) 18
Manitoba	11	3	7	No information
British Columbia	No information	0	0	None
Alberta	25	7	9	None
Saskatchewan	35	11	17	No information
New Brunswick	21	2	6	(1920-30) 5
Nova Scotia	35	0	4	None
Prince Edward Island	2	0	0	None
	995	140	241	68

*64 municipalities supplied with filtered water and 40 with chlorinated water.

TABLE D

PASTEURIZATION OF MILK

Province	Municipalities where Pasteurization is employed	Milk-borne epidemics
Ontario	106	(1911-30) 17
Quebec	41	No information
Manitoba	No information	No information
British Columbia	*3	Since 1922 2
Alberta	0	1
Saskatchewan	3	No information
New Brunswick	3	0
Nova Scotia	2	2
Prince Edward Island	1	0
	159	22

*Several municipalities served from the three plants.

In studying the cause for the Dominion-wide decline, three outstanding features are involved: (1) the filtration and sterilization of public water supplies, (2) the pasteurization of milk, and (3) prophylactic vaccination. Regarding water treatment, we find that, since 1911, 140 water purification systems have been built and placed in operation, while several more are at present under construction. The

slow decline in typhoid fever as a direct result of filtration alone was pointed out as early as 1911, but it was not until the succeeding years following the general adoption of sterilization by means of chlorine that a sharp decline occurred. The fact that many epidemics have been completely checked following sterilization of the water, indicates that this method still remains the most effective means of combating water-borne disease. At this stage one would be very remiss if due recognition were not given to Sir Alexander Houston, Director of Water Examination, London, England, for the enormous part he played in controlling water infections. As the first sanitarian to use chlorine for disinfection of the Lincoln water supply in the midst of a serious typhoid fever epidemic in 1905, the world owes him a debt of gratitude that can never be repaid. At the present time, there are in Canada 241 municipalities practising chlorination of their water. Exclusive of Quebec, British Columbia and Prince Edward Island, 54.2 per cent of all treated water is being sterilized.

The part played by the pasteurization of milk is small in comparison with the results obtained by water sterilization, due in part to the comparatively small number of municipalities employing pasteurization. Yet we are faced with the fact that in all cases where pasteurization of milk is efficiently carried out, the possibility of milk-borne disease is eliminated. As judged by the number of milk epidemics reported and unreported in the past 20 years, this source of infection has played a considerable part in disseminating typhoid fever, gastro-enteritis, septic sore throat, tuberculosis and other diseases. In Montreal alone in 1927 over 5,000 cases of typhoid fever occurred. In considering the infantile mortality rate due to gastro-enteritis, we find that the death rate has markedly declined in all municipalities employing the pasteurization of milk. At the present time, there are 159 municipalities wholly or partially employing pasteurization, of which 106 are in Ontario and 41 in Quebec, leaving only 12 in the rest of the Dominion. This number is ridiculously small and is possibly influenced by the present time inability of the provinces to enforce pasteurization.

The third measure which has aided considerably in the prevention of typhoid fever is prophylactic vaccination. Some few years ago when epidemics were common, the vaccine was generally employed in camps and when visiting infected areas. In 1930, following a water-borne typhoid epidemic in Chandler, Quebec, over 1,600 citizens were given immunity by vaccination. Clean-cut information clearly indicates the important part played by typhoid fever prophylaxis.

In summarising the subject as a whole, we are impressed by the grest strides made during recent years, but deplore the fact that "a large amount of preventable typhoid fever still exists." We find specific but incomplete information covering seven provinces in which no less than 68 epidemics of water-borne typhoid occurred, of which a major part should not have been possible in the light of modern prac-

tice. Similarly, exclusive of Quebec, Manitoba and Saskatchewan, for which no information is available, 22 epidemics were directly attributable to milk infection. Were the statistics complete, these figures would doubtless be more than doubled. If municipalities would ever bear in mind the enormous financial loss resulting from preventable water- or milk-borne epidemics, to say nothing of the unenviable resultant notoriety, details of which are frequently broadcast throughout the world, epidemics would no longer occur.

The compulsory sterilization of all water supplies of questionable character; legislation to isolate and provide a means of livelihood, when necessary, for typhoid carriers; enforced municipal pasteurization of milk; adequate control over shellfish and food liable to cause infection: these would practically eliminate typhoid fever, or at least reduce the figure to endemic rates of less than 1 per 100,000 population.

To reduce further the rate in Canada, aggressive legislative action free from political and municipal interference would seem to offer the only immediate means of accomplishing the objective.

In conclusion, the writer desires to acknowledge the assistance given him by the many provincial officials throughout the Dominion in the preparation of statistics contained in this paper.

Public Health Engineering Organization in Canada

PUBLIC health engineering or sanitary engineering has long been an essential part of the program of well organized health departments. Engineering activities of the public health organization of Canada have developed in a manner similar to those in the United States. The various states have public health engineering divisions in which certain responsibilities are allotted. There is, in addition, the engineering branch of the United States Public Health Service, charged with important duties. The two work together, and also with the municipal organizations.

In Canada the Federal organization includes an engineering branch of the Dominion Department of Pensions and National Health. One of the important duties of this office comprises the supervision of water supplies on common carriers. Co-operation with the different provinces and provision of engineering personnel where no other is available has made the branch very valuable. In four of the provinces, engineering divisions have been organized. These are—Quebec, Ontario, Saskatchewan, and Alberta. Their main duties include supervision of water supplies and sewerage systems, milk supplies, garbage disposal, recreational sanitation, and all problems in which sanitation is a factor. The next link in the organization is the municipality. In some of the larger centres public health engineers have been appointed. In others their work is carried on by the municipal engineer in conjunction with the medical officer of health.

Planning Sewage Systems for Public Health Requirements*

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A MAGISTRATE in one of our Ontario cities recently remarked that the Public Health Act of Ontario was outstanding among the Provincial Statutes, not only for the power with which it clothed civic and governmental officials, but also for the clarity of its phraseology due to the time and thought involved in its preparation. Those who are engaged in the field of sanitation in this province are fortunate in having behind them the moral force of legislation which is reasonable in its demands and practical in its application.

If sewage systems are to be planned to meet public health requirements, we must primarily ascertain to what extent existing legislation controls, governs or restricts the design, construction, operation and maintenance of sewerage systems in this province. No system of drainage involving the transportation of domestic wastes may be inaugurated or extended without approval of the plans and specifications by the Provincial Department of Health. A certificate of approval is possible only after due investigation has been made by departmental officials who are fully qualified to deal with the facts pertaining to the work and the attendant results. While not interfering in the slightest degree with the professional engineering consultant, the Provincial staff may add and does offer valuable suggestions with respect to plans submitted to them, with resultant economy in construction and efficiency in operation. Municipal by-laws may not be passed for work of this character until the stamp of approval has been received from the Department. Where there is any unwillingness on the part of the municipality to undertake drainage work which is essential to public health, the Department may issue a mandatory order obligating the municipal council to pass the necessary by-laws so that the work may be undertaken. When once placed in operation, sewerage systems must be maintained and kept in repair as may be directed by governmental officials.

If the most imperative need of a modern city is its water supply, the next in point of urgency among its daily requirements is the removal of wastes. Any cessation in these two public services would cause acute discomfort and distress within twenty-four hours. Public sanitation is therefore entitled to a place at the top of the list of the essential requirements of every community. It might be briefly

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defined as the act of removing objectionable wastes in the most unobjectionable way.

The layman thinks of sanitation as a branch of public health, but this is correct only with limitations. No urgent consideration of public health is included in the removal of ashes, snow or trade refuse. Rubbish and garbage are offensive to the eye and nose, but only indirectly is their presence fraught with serious consequences. There is one form of waste, however, which, when not subjected to control, is a constant menace to health. Sewage is the most troublesome of city wastes and the largest in point of volume. The combined quantities of garbage and ashes in an average city may vary from 5 to 10 lbs. per capita per day while the liquid sewage wastes will amount to 800 lbs., based on a per capita consumption of 100 gallons of water and assuming that 80 per cent is returned to the sewers. The actual organic matter which it contains is usually not more than one part per thousand, yet under favorable conditions it may produce mortality rates which are appalling.

Sewers were originally designed for public convenience, not for health or sanitation. Sewers in ancient Pompeii were shallow, rectangular depressions in the centre of the street, with stepping stones in the centre by which pedestrians could cross from side to side. Their original purpose was to serve the streets and public institutions rather than the homes. They frequently emptied their contents into the source of water supply. Even yet, indeed, this policy has not been entirely abandoned. It is, or should be recognized that water supply and sewage treatment in a community are a single problem and that they cannot be considered independently.

Because of the growing popularity of outdoor recreation, made possible through the almost universal ownership of low-priced cars, legislation has become conscious of the necessity of protecting streams and other bodies of water from pollution, thus removing a potential menace to all those brought in contact with them. It is a well-established law that a municipality is liable for damages for construction of a sewerage system which pollutes running water or otherwise effects damage to property. Generally speaking, a municipal corporation situated on an arm of the sea, adjacent to tidal waters, has the right to use those waters for the purpose of carrying off its sewage so long as such use does not create a public nuisance. There is a marked and well-established distinction between the pollution of a small non-navigable stream and the pollution of large navigable bodies of water. In the first case, the bed of the stream and the water are owned by the riparian owners, while in the latter case the bed and the waters are owned and controlled by the government for the use and benefit of the public, subject only to navigation. It must be admitted that, under all circumstances, pollution of water used for domestic purposes, being detrimental to the health of the users, is objectionable, if not illegal, and should be prevented.

Sewerage systems and city planning have something very much in common. Very little serious attention is given to either until expen-

sive corrective measures are necessary. They develop coincidently, piecemeal in character, and it is usually congestion in both cases which calls for diagnosis and treatment. It would not be a difficult problem to plan a system of drainage for a city in a definite location and with a fixed acreage. With area an unknown quantity, drainage is provided only as the need appears. Consequently, as the area is extended, the original drains become inadequate and relief measures must be inaugurated.

In designing any system of drainage, a topographical map of the area under consideration is the first essential. It is equally necessary whether the ground is almost level or whether the natural grades are steep. Not only topographical maps are necessary, but sub-surface maps as well, showing the location of all water pipes, gas mains, telephone and fire alarm conduits and all other possible obstructions to the direct passage of sewers. Whereas watermains can be lowered or diverted when obstructions are encountered, sewers should preferably be in a straight line both as to direction and grade. In the absence of such maps, accurate plans cannot be made either for the present or future and more money is wasted in construction than the plans would cost.

If a new system is under consideration, the first decision to be made by the designing engineer deals with the desirability or undesirability of keeping domestic wastes separate from storm water; that is, a separate system or a combined system. In some instances the final decision can be made only after both systems have been designed and comparative cost estimates prepared. Each has its merits and due consideration must be paid to all the factors involved. When storm water must be carried from large areas for long distances, combined sewers will generally be cheaper. In densely inhabited areas, the proportion of sewage to rain-water will be greater, with resultant larger separate sewer system sizes but without decreasing the size of the storm sewers. It is a rule-of-thumb that if storm sewers are of adequate size, no increased provision need be made for domestic wastes. Separate systems are frequently desirable where purification is necessary or where the river or creek into which it discharges is so small that even dilute sewage from storm water overflows would be objectionable. When pumping of sewage becomes necessary in order to drain low-lying or flat sections of the community, the cost of lifting storm water becomes almost prohibitive. Frequently, owing to the lesser depth necessary and the flatter grade permissible due to their larger size, outlets are available for storm sewers without pumping, which are not possible with the deeper ones carrying domestic sewage. The necessity and degree of ultimate sewage treatment is probably the determining factor, for, if the sewage is merely poured into the ocean or a river, the advantages of a separate system are less than when every gallon has to undergo treatment. The 1931 issue of the Municipal Index contains a list of communities in the United States having a population in excess of 1,000 persons. Although the information is not complete,

574 of the 977 communities reporting were sewered on the separate system, 286 combined, and 117 utilized both methods. Incidentally, 103 discharged sewage into the source of water supply.

The methods involved in sewer design, either separate or combined, are similar. In the former case, the sizes are governed by the per capita use of water, the population per unit of area, and the leakage into the sewer, depending on the character of the soil in which it is laid. There is a period of maximum flow in separate sewers corresponding to peak demand in water supply, and in the design this element must be recognized. The size of storm sewers is dependent on the intensity of rainfall in the district and the character of the area, either porous or impervious, from which run-off takes place. In the design of both systems, the sections most remote from the outlet are given first consideration. As area increments are added, the cross-section of the drain and the slope necessary are selected to insure delivery of the progressively increasing quantity of sewage or storm water. In separate sewers, considerable care must be exercised in determining sewer grades; stranding of solids will occur if the velocities are either too high or too low.

Where separate systems are to be utilized, it is extremely necessary to exclude rigorously all roof water from the smaller sewer. An 8-inch pipe laid on a minimum self-cleansing grade is sufficient to carry the domestic wastes of 1,000 persons. This 8-inch sewer on the same grade will not carry the storm run-off from one acre. Flooding of basements is the natural outcome of allowing even a few roof connections to be drained into the sanitary sewer. Under the separate system, the two house drains are usually placed in the same trench and it is equally important, but for entirely different reasons, that the domestic service should not be connected to the storm sewer. This may discharge into a ditch or small watercourse in which there is little if any dilution for a great part of the year. Even a few house services gone astray in this manner will create conditions which are extremely offensive.

In rural areas which are gradually becoming urban in character, due to their proximity to large cities, it is not unusual to utilize storm sewers for the removal of domestic wastes. This is done through the interposition of a properly designed septic tank on the house service with the effluent passing into the storm sewer. Under the best of conditions it is not satisfactory but it provides a measure of sanitation for the district until such time as it has the financial resources either to install a system of separate sewers or to provide sewage treatment for its wastes.

Vitrified clay pipe up to 36-inches in diameter is an extremely satisfactory material for transporting sanitary wastes. For larger sewers or for egg-shaped sections, brick has been used to a large extent. In recent years, monolithic concrete with or without a protected invert is being utilized in sewers up to 20 feet in diameter. The unfortunate results which attended the early use of concrete and concrete pipe in contact with sewage has to some extent reacted against its general acceptance in this field. However, with improved methods of manu-

facture and with strict supervision in the selection of the materials used, there is now little question as to its acceptability.

When waterfront improvement is undertaken in a community, it frequently becomes necessary to construct intercepting sewers to prevent the indiscriminate discharge of sewage along the river or lake front. The sewage is picked up from the lateral drains and transported to a single outlet or to a treatment plant. Intercepting sewers are frequently of sufficient capacity to handle domestic wastes only, with overflows for the storm flow. Regulators are constructed between the lateral and the interceptor which limit the amount of sewage admitted to the interceptor to the normal dry weather flow. This arrangement removes all sewage from the river or lake for about 95 per cent of the time where there is a precipitation of about 30 inches per year.

When the sewers are extended in piecemeal fashion, the time almost invariably comes when the original sewers at the outlet become too small for the burden imposed upon them. It then becomes necessary to construct trunk or intercepting sewers at a higher level in order to prevent flooding of premises in the lower levels.

Sewage pumping stations impose a constant and perpetual charge on the municipality where their construction is necessary. It is sometimes more economical, however, to meet this charge rather than to carry sewers for long distances at excessive depths. Pumping stations are usually designed with either horizontal or vertical motor-driven centrifugal pumps. They come into service automatically, being submerged, and require a minimum of attention. There is a considerable measure of flexibility in the units installed so that an increasing number of units operates as the sewage flow increases.

The actual collection of a city's sewage is only half, and sometimes less than half of the problem. Getting rid of it after it has been collected is sometimes a far more difficult undertaking. Where there is ample dilution available, this provides a simple means of disposal. But inland communities often find great difficulty in handling their daily volume of sewage. In such cities, and even in communities on our Great Lakes system, the construction of a treatment plant is the only practicable solution. Treatment plants are not designed to purify sewage; their function is to produce an effluent which will not constitute a menace. A good effluent is one which can be discharged without further cause for concern on the part of the community which is responsible for its production.

The processes of sewage treatment are numerous and include screening, straining and roughing, plain sedimentation, chemical precipitation, Imhoff tank retention, the activated sludge process and various forms of filtration. Screening is the simplest of all sewage treatment methods. Fine screens mechanically operated will remove 25 per cent of the suspended materials. Plain sedimentation is used in many cities in Europe and America. The process consists in allowing raw sewage to flow into and through tanks so that the suspended material may settle to the bottom. The sludge must be removed at

frequent intervals. The disposal of large volumes of sludge is almost always a difficult, disagreeable and expensive problem.

The latest and probably most efficient means of treating sewage is through activation of the sludge. This consists in forcing air through plates in the bottom of the tanks by which the suspended matter is finely disintegrated. Passing into settling tanks, the sludge settles, part of it being returned to the aeration tanks as activating material while the balance is drawn off and discharged upon drying beds, frequently glass-covered, and then used either as fertilizer or as innocuous fill on low-lying ground. In some plants the sludge is specially processed and bagged as fertilizer, the removal usually being about equal to the cost of preparation; but more important, the sludge is finally disposed of.

Which type of disposal is best? To this question no arbitrary answer can be given. The topography of the city, the volume of the sewage to be treated, the presence or absence of trade wastes, the availability of cheap and suitable land for a plant, the nature of adjacent waterways, climate, rainfall, financial resources—these and many others must be taken into account. The decision should never be left to a layman unguided by technical advice. This decision is all the more essential because of the constant progress being made in the field of sanitation. New processes and added refinements are constantly coming to the fore and these innovations may demonstrate the supremacy of some system over any methods now in vogue.

It is interesting to note the increasing number of cities which are charging sewer rentals as an equitable means of financing and maintaining treatment plants. Some rentals are based on lot frontage, others in proportion to the amount of water metered on the premises, while others again which are unmetered set a charge based on the number of taps or fixtures within the household. Previous reference was made to a tabulation in the Municipal Index. Among the cities reporting, 109 charged some sort of sewer rental. In some cities in Germany the tax is a function of the rental value of the property served.

Sewer construction in Ontario is financed largely as a direct charge against the property benefitted. In storm sewer construction, all sewers having a greater sectional area than 4 sq. ft. are a charge against the community at large. Sewage treatment plants are financed on the credit of the entire municipality and the operating costs are levied on the city at large.

The modern treatment plant to-day is attractively designed and if placed in the hands of competent operators should be no more objectionable than any other municipal utility. In a large community it should be operated by a technically trained man with special qualifications for the post. The laissez-faire methods in civic policies in failing to provide sufficient funds for competent plant operation is largely a thing of the past. It is the poorest sort of economy to underpay the head of this service. From the viewpoint of health protection it is impossible to place a too high value upon a modern system of waste disposal.

Municipal Cleanliness

REFUSE collection and disposal forms a very essential part of the sanitary program of a municipality. It tends to keep the community clean, and to reduce nuisance complaints to the minimum. From the latest available returns, in the province of Ontario there are over 55 municipalities in which regular garbage collection is provided. Thirty-six per cent of these have collections twice a week. Most of the remainder have weekly collections. Disposal of this material is carried out by a number of methods. Dumping is the most common method, and is practised in 65 per cent of these municipalities, but incineration is increasing. As the municipality increases in size and dumping grounds become scarcer or more remote, incineration generally follows; 12 per cent of the centres are now using incinerators.

The cost of garbage collection and disposal is not so high as some people might imagine. The statistics from these Ontario municipalities show the

SANITARY GARBAGE DISPOSAL IS HEALTH INSURANCE.

average per capita cost at 60 cents per year. This averages between $1.50 and $1.75 per residence. These figures are quite low when viewed in the light of the service provided.

Delay in initiating municipal programs is difficult to understand. Fifty-five municipalities so served in the whole province is a figure entirely too small. Compare this with nearly 300 waterworks systems and 130 sewerage systems, and the low figure for garbage systems becomes even more pronounced; yet the cost is lower than for either waterworks or sewerage. It cannot be due to lack of public support, nor, from these figures, can it reasonably be attributed to cost.

Observations in different centres cannot fail to impress with the thought that the most probable factor is lack of initiation. The municipal officer, be he engineer, clerk or health official, knowing the true situation as to advantages and costs, should lead in an effort to secure a modern system for efficient collection and sanitary disposal of all municipal refuse.

Etobicoke Water Softening Plant

A NEW and interesting water treatment plant is to be installed in the Township of Etobicoke. The contract has been let and work will start at once. This plant marks a new departure, in that it will be the first water softening unit to be installed on a municipal supply in Ontario. This type of treatment is common for industrial use, and has also been utilized for many hard waters in United States' municipalities. The increasing use of deep wells in Ontario with, in many cases, hard water supplies has brought into prominence the question of softening.

The Township of Etobicoke has not in the past had any water supply works of its own. Water was secured from New Toronto. This is taken from the lake and filtered. Recently a contract was let to develop an underground water supply. A flow in excess of one million gallons per day was secured, but this was hard, and contained so much iron that it was not feasible to use it without treatment. The soap-consuming power or hardness of the water was approximately 325 p.p.m. The iron content was 1.4 p.p.m. Other constituents were not objectionable.

In studying the situation, the Township Engineer, Mr. Walker, was faced with a number of alternatives. The iron alone might be removed by some form of aeration followed by filtration through pressure filters. This would remove an objectionable chemical—one which would interfere with laundry work, industrial processes and cause staining in sanitary fixtures. The removal of this iron would still leave a hard water, and one which would not be favored by industries. There would also be a heavy consumption of soap in the home. The Engineer, in forming his conclusion, rightly points out that a very great saving in soap can be made by softening this water. He accordingly recommended to his Council that the water be treated to reduce the iron to 0.3 p.p.m. and the hardness to 80 p.p.m. The City of Toronto water is over 100 p.p.m. hardness.

The objective in the treatment of this water was adopted by the Council, and there remained the selection of a type of treatment to accomplish this end. Various methods might be used, but three were chiefly considered. They were:

(*a*) The lime-soda method,

(*b*) The zeolite method, and

(*c*) A combination of the above two.

Bids were accordingly called for on these different processes. The final selection was the zeolite method or base-exchange process. This choice was governed by initial cost, operating costs, and ease of operation.

The Zeolite Process:

The zeolite process of water softening has been used for many years. It is a base-exchange method in which the hardness constituents of the water are replaced by others from the zeolite. These latter do not cause hardness. The sodium of the zeolite replaces the calcium and magnesium of the water. Iron may also be removed in this way. As the sodium of the zeolite becomes exhausted, it is replaced by common salt, and in this way the process is carried on. The zeolite is contained in filter shells and in this case the water will pass down from the top, as in a pressure filter.

The Etobicoke installation will have a capacity of nearly 1½ million gallons of water per day. The plant will consist of four units with salt handling and other necessary appurtenances. The zeolite used will be a natural sand. The contract for the installation amounts to approximately $15,000.00. The cost of treated water from this system has been estimated at five to six cents per thousand gallons, a figure which is indeed very attractive.

Continuous Water Chlorination

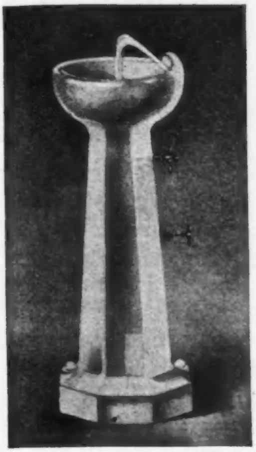
THE water supply for the town of "A" was taken from a source which required treatment. Chlorination only was in use. The results had been satisfactory and no illness had been attributed to this water. A condition arose, however, which changed this completely. One day the operator of the plant attempted to make a slight repair to the chlorinator. To do this he shut off the chlorine, but continued to operate the pumps and deliver untreated water to the municipal mains. This continued for about half an hour and the machine was again put into service. All went along as usual for a time, and nothing was thought of this lapse in the treatment, since similar shutdowns for short periods had been made before. In about ten days following this occurrence typhoid fever began to appear in the town. Investigation showed that every case had used the municipal water supply. The number of cases reached a total of 20, and the epidemiological study showed conclusively that only this water was common to all. As might be expected, chlorination had been stopped once too often, and contamination happened to be present when the repairs were being made.

In Canada a great many municipalities are dependent upon chlorinated water. The nature of the pollution in practically all of these supplies demands continuous treatment rather than intermittent application for so-called emergency conditions. Supplies of this type necessitate absolutely continuous operation of the chlorination equipment while the pumps are running. A moment's shut-down may be sufficient to produce serious results. Every operator should be thoroughly impressed with the necessity for continuous operation, and the application of the correct dosage. The man who operates a chlorination plant has the health and lives of the water consumers under his charge, just as the engineer who guides the train. No laxity or carelessness on his part can be tolerated. The operator who is unable to appreciate this danger can find little justification for his employment.

Emergencies in chlorination are certain to occur, and every operator should be ready to meet them. But running out of a supply of chlorine is no emergency; it is gross negligence on the part of those responsible for the supply of this chemical. Liquid chlorine does not deteriorate; an adequate supply can and should always be available and secured well in advance of requirements.

When a breakdown or stoppage occurs in a chlorinator, the pumps should be immediately stopped until the equipment can be repaired, or a temporary arrangement made for emergency operation. Facilities and spare parts for temporary use should always be at hand, and the operator thoroughly familiar with their employment. The damaged part, or the entire machine, can be by-passed and chlorine fed to the supply. This will, of course, not be so readily controlled, and may cause taste, but safe water can be secured in this way with careful attention and supervision. A further emergency measure consists in having a supply of hypochlorite of lime always ready, should the liquid machine refuse to function. A duplicate equipment is, of course, most satisfactory and affords an additional safeguard, especially where the pumps normally operate continuously. This latter safeguard is being taken more and more in these plants. It is a very worthwhile investment and insurance.

Sanitary Drinking Fountains



HEALTH officers have persistently waged war against the common drinking cup. Their efforts have, for the most part, been successful, and it is now seldom that cups are seen in public places, where all may come and drink. This objectionable practice has been replaced by individual paper cups and sanitary drinking fountains.

Individual paper cups are both inexpensive and sanitary. A variety of shapes and kinds are available. Suitable containers for different purposes may also be had. The use of these cups is finding increasing favour in schools, and the tendency is also to use them at soda fountains and all refreshment booths.

Drinking fountains have played the most prominent part in the removal of the common cup. Especially is this the case in parks, on street corners and in the larger factories and buildings. A great variety of these is to be found, and it is very doubtful if some of them are more sanitary than the cup. The objectionable ones permit the lips of the drinker to come in contact with the jet orifice. Observation of the habits of those drinking from these fountains leaves little to be desired to convince one that precautions are necessary to correct these defects.

Drinking fountains which are really sanitary are now available. Their construction includes certain essential principles.

The main requirements are as follows:

(1) The jet of water as it issues from the orifice should travel at an angle rather than vertically. This prevents water from the lips of the drinker from falling back on to the orifice.

(2) The orifice should be protected by a guard of some kind to prevent contact with the lips of the drinker.

(3) The orifice should be so placed that any stoppage in the outlet pipe will not permit waste water to reach and contaminate it.

Before any drinking fountain is selected, assurance should be had that these points are embraced in the design.

A check up on existing fountains is likewise very desirable.

Gravity Flow Fountain.

Where a pressure water supply is not in use, another type of fountain combined with a water container and water basin can be had. This is illustrated here. It is very satisfactory for schools and factories. If the water requires treatment, it may be chlorinated in the container when added.

Editorials

MUNICIPAL SANITATION

THE topic to which this issue of the JOURNAL is devoted has come to assume a position of major importance in municipal activities. It vitally concerns the health and welfare of all citizens. It also costs a good deal of money—a further incentive to its efficient operation.

Urban municipalities pride themselves on low death rates. A reversal of conditions in urban and rural communities has taken place. The rural area can no longer claim to be more healthy than the urban. This has been made possible in part by the application of sanitary science. Municipal sanitation has reduced typhoid fever in urban centres to almost the vanishing point. In a summary of the typhoid statistics in large American cities, this disease shows a steady yearly decline. In a great many it has been almost entirely eliminated. Similar figures are obtained from Canadian cities. Other diseases of urban centres have likewise been attacked through improved sanitation, although the results have probably been less spectacular.

Persistent efforts have been made to create in the minds of the public the ability of a community to purchase public health. If this be true, then no greater opportunity for its fulfilment exists than in the field of municipal sanitation. Here the results can be very apparent and specific. Criticism of the inadequacy of expenditures on public health as compared with other governmental programmes has been frequently voiced. For the larger United States cities a summary of these figures has just been issued for the year 1930. They show, as in former years, that sanitation and public health receive but a small portion of the total municipal expenditures. For the operation of general departments in these cities the highest expenditure was for education, 19.6 per cent of the total; while the lowest was for conservation of health, 2.5 per cent. Sanitation claimed 7.2 per cent. Are these figures to be interpreted as inadequacy of expenditures on sanitation and public health, or can these activities be effectively performed at lower costs than the others?

Municipal programmes of to-day are indeed comprehensive. From the earlier field of control over water supplies and sewage disposal only, the circle has gradually expanded to take in such matters as milk control, garbage collection and disposal, recreational sanitation in all its forms, food control, street cleaning, plumbing and many others. This has been brought about not only in the interests of disease suppression, but also for the welfare and comfort of the citizens.

To-day there is a greater tendency to regard municipal sanitation in the proper perspective. Before the knowledge of germ life had become clear, the sanitarian was concerned with the absolute cleanliness of the municipality. His knowledge led him to believe that only in this way could he cope with infectious disease. To-day cleanliness is still desirable, but undue stress for the sake of public health is not placed upon the removal of all forms of refuse and municipal wastes. Ashes and dry inorganic refuse may be offensive to the eye, but to claim that health is endangered by their presence is another matter.

Municipal sanitation has in no way reached its summit. There are many problems to be dealt with and many programmes to be established both in the large and smaller centres of population. Water supplies, in spite of their long recognition, can have many improvements. A great many urban centres still rely upon individual wells instead of safe municipal supplies. These wells generally show heavy pollution. Recent surveys by the Ontario Department of Health have shown that the wells in the various centres are grossly polluted to the extent of 50 to 99 per cent of the total. There is work to be done in this field. Sewerage facilities are likewise inadequate in many centres. Systems are delayed and full use is not made of the sewers for some time after they are built. In milk control the field has scarcely been scratched and it lags far behind in measures similar to those which have been applied to water supplies. Garbage collection has not been utilized by the municipalities at all as it should be. Some of the many other problems are better control over food supplies, more careful attention to soft drink manufacturing; closer supervision over swimming facilities, and a great many other similar problems. In most of these fields the technique has been established. Will the municipalities make full use of these established principles and practices?

A. E. Berry.

ENGINEERING AND PUBLIC HEALTH

PUBLIC health deals with the application of science to the problem of man's relation to the environment. Its task is to assure the necessary favourable contacts and to prevent or to minimize the unfavourable. Its problems are manifold, and to their solution it brings the resources of many of the fundamental branches of science.

Investigation has provided a great fund of knowledge concerning the reactions of man to the most varied of environments from which it is possible to determine, to a large extent, the most favourable conditions for the health and well-being of the human species and the least favourable for the activities of man's enemies. Present day public health practice recognizes that it is possible to control and modify the environment.

The control of the environment is obtained by directing the forces

and activities of nature for the protection and improvement of the public health.

Given the underlying biological data, it is the province of the engineer to design, construct and operate the works necessary for the desired control of the environment.

In the course of an address at Montreal in September, 1931, Professor Prescott stated that: "The contribution which engineering has made to public health work in the past fifty years is an outstanding one. In this period, the medical man, the sanitary bacteriologist and the engineer have worked together for the control of certain types of communicable diseases, which, while not complete, is extensive enough to provide the evidence that it is quite within the power of man to reduce them to comparative insignificance." To-day in Canada typhoid fever and dysentery are very greatly reduced and continue to decline especially in those portions of the country where public health engineering bodies function. This has been largely due to purification and careful control of water supplies and to extension and improvement of sewerage facilities and the development of methods of treating sewage and preventing direct contamination from excreta. This very desirable condition was emphasized during the discussion that followed the remarks of Mr. Norman Howard, at the annual meeting of the Public Health Engineering Section of the Canadian Public Health Association in Toronto last May, regarding "The successful fight against typhoid fever in Canada during the past twenty years."

The lowering of the death rate from communicable diseases in general has been due to numerous factors, but to a great extent it has been the result of the securing and maintenance of a better environment through the application of public health engineering.

Preventive medicine is often more closely associated with certain engineering problems than with medical practice; and in Canada and the United States certain engineering schools have provided courses of instruction in public health engineering.

G. H. Ferguson.

AMERICAN PUBLIC HEALTH ASSOCIATION: ANNUAL MEETING

MEMBERS of the American Public Health Association in Canada are looking forward with great interest to the 61st annual meeting, which will be held in Washington from October 24th to 27th, inclusive, with the Willard Hotel as headquarters. One of the features of the meeting will be the holding of a Health Education Institute immediately preceding the meeting proper. By this arrangement, a short intensive course is available for those interested in the subject of health education and publicity. Detailed information concerning the programme of the meeting, hotel arrangements and the programme of the Health Education Institute may be obtained from the Association's office in New York.

Public Health Engineering

T. J. Lafrenière, C.E., and A. E. Berry, M.A.Sc., C.E., Ph.D.

Summer Problems

A. E. Berry

THIS is the season of the year when sanitation problems emerge to the fore. The health officer is generally kept busy answering complaints. Odors are at their peak. Decomposition of organic material is rapid and nuisances soon follow unless proper care is taken. Stream pollution becomes more intense by reason of the water temperature and low flows. Many processes, such as canning, are in operation only in summer. Tastes develop in water supplies and algae odors are at their worst. Insects have their day and outdoor recreational facilities, now in full operation, require much supervision. In all of these difficulties the health official is expected not only to find the proper solution, but to take the necessary action without delay.

Summer problems are frequently the result of carelessness, but in many cases it is difficult and often very expensive to avoid nuisances. Two of the industries from which most complaints arise at this time are canning factories and milk plants. The former are operated for such short periods and discharge such large quantities of wastes that treatment may be unduly expensive for the industry. The latter discharge very concentrated wastes and offensive odors result when these are run into small quantities of water.

Treatment of canning wastes may be simplified by separating the clear water from that containing organic wastes. The latter must be treated unless dilution is adequate. The use of fine screens has become standard equipment for these wastes. Following this, a system of filtration or chemical treatment will prepare the liquid for final discharge. Where land is available, it can be successfully treated by utilizing this as a filter. Odors also originate at canning factories through the storage of corn husks and pea vines. These should always be stacked at some distance from residences.

Milk wastes are a year-round problem. Many of the plants discharge their wastes into small streams. Complete treatment is thus made necessary. The recent trend in the treatment of these wastes is to provide a very short, if any, period of detention, and follow this with filtration. This is exactly opposite to the former procedure of providing lengthy sedimentation with the object of digesting the material.

Odors from unexpected sources may be encountered at times. Where shore formations are suitable and where food is plentiful, algae may grow in such profusion as to cause a nuisance. Reports are not infrequent concerning very offensive odors

from the decomposition of algae in shallow water near shore. Where heavy growths of algae are washed into confined bays, a lack of food and other requirements may cause decomposition to set in. The solution of this appears to be the removal of the accumulation before putrefaction begins.

Many other decomposition problems arise in summer. Some have recognized and well established methods for abatement; others require careful investigation and study.

News of Engineering Interest

Work is starting at once on a water filtration plant at Huntsville, Ontario. This is to be a gravity mechanical system with a capacity of 600,000 gallons per day. The water is taken from Verner Lake. It is colored and contains a good deal of iron at times. This addition should make the supply a very attractive one and prove a valuable asset to this town. As a tourist attraction it should also be important.

ALEXANDRIA WATER WORKS

The village of Alexandria, Ontario, has had under consideration for some time its water supply problem. Wells were investigated but proved inadequate. Two sources of supply, neither one satisfactory without treatment, were possible. After investigation of these, it was decided to continue use of the present one. This is from a small stream impounded by a dam. The treatment, to be established, will be gravity mechanical filtration and chlorination.

WESTON DEEP WELLS

The town of Weston, after persistent and concentrated efforts, appears to have been rewarded by securing the desired underground water. Wells have been developed which, upon test, have produced a flow of approximately 1000 gallons per minute. The water is quite palatable and has low chloride and iron contents. It is somewhat hard, with a soap-consuming power of about 325 p.p.m. This supply should be available to the water consumers very shortly. It will be a welcome change from the present supply from the Humber River.

Tenders have been called by the Village of Shelburne for a deep well water supply. The wells now in use have proven inadequate to meet the maximum demand. The successful tenderer must guarantee a definite quantity of suitable water.

The City of Stratford has recently opened a public outdoor swimming pool. This is one more municipality which has provided this popular and necessary recreational facility. It is built in a central place and will no doubt be well patronized by the citizens of that city. The city is to be congratulated on its action.

At Timmins, Ontario, plans are being prepared for alterations to the sewage disposal plant. This is an activated sludge plant, which was built about ten years ago. It is to be enlarged by additional aeration capacity, a new reaeration chamber, and a final clarifier. The effluent is discharged into the river.

TILBURY WATERWORKS

The new water supply was turned on at Tilbury, Ontario, the end of July. For some years this system has supplied water for fire protection only. The water was from an unsatisfactory source. The municipality decided to secure a new source, and built an intake and supply works at the lake. This consists of filtration and

chlorination. Before the water was used for domestic purposes, the mains were heavily chlorinated and all sediment flushed out. The completion of this system has removed one more of these fire supplies. Their use is always a menace where connections are permitted to residences.

The Provincial Department of Health of Ontario has recently completed investigations on the milk pasteurizing plants at Brampton, Port Dover, Morrisburg, Carleton Place, Peterboro', and St. Mary's. These were made at the request of the local Health Officers.

The sewerage system construction at Fergus, Ontario, is nearing completion. Favorable progress is also being made on the sewerage system at Aurora, and on the sewage disposal plant at Mimico. The extension to the outfall sewer of the latter has been in use for some time.

REPORTED CASES OF CERTAIN COMMUNICABLE DISEASES IN CANADA* BY PROVINCES—JUNE, 1932.

Diseases	P.E.I.	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
Diphtheria	—	5	1	92	94	39	12	4	4
Scarlet Fever	2	52	34	272	217	47	5	7	27
Measles	1	40	19	253	3753	284	46	349	243
Whooping Cough	—	13	—	169	455	57	78	19	119
German Measles	—	—	—	15	15	†	8	8	3
Mumps	—	20	—	115	979	44	11	2	93
Smallpox	—	—	—	—	—	—	3	—	1
Cerebrospinal Meningitis	—	—	—	3	2	1	—	—	—
Anterior Poliomyelitis	—	—	—	—	—	—	—	—	—
Typhoid Fever	—	—	8	235	36	—	3	3	4
Trachoma	—	—	—	—	—	22	1	—	—

*Data furnished by the Dominion Bureau of Statistics, Ottawa.
†Not reportable.

NEWS AND COMMENTS

P. A. T. Sneath, M.D., D.P.H.

IN recognition of the comprehensive programme of maternal welfare carried on by the Victorian Order of Nurses for Canada, the Rockefeller Foundation has extended to Miss Elizabeth Smellie, its Chief Superintendent, an invitation to visit a number of European countries within the next few months to observe and study conditions in maternal welfare there. Miss Smellie expects to sail from New York early in September, visiting England, Denmark, Austria, Germany and Italy, and returning to Canada about the middle of December.

The International Hospital Association, organized last summer, manifests a very satisfactory development, notwithstanding the world-wide economic depression. Up to the present, fifteen national hospital associations have joined it, and five of the eleven study committees organized have brought their preliminary work to such a point that it has been possible to print their programme of work in the second number of the third year of the Association's official journal, *Nosokomeion,* recently published. The study committee's pro-

grammes indicate the great number of problems connected with modern hospital services and constitute a collection of material scientifically and systematically brought together which should render valuable service in all professional fields and to all leaders who are developing hospitals into health centres for towns and districts.

Saskatchewan

THE Saskatchewan Relief Commission recently made provision for additional financial assistance to government-aided hospitals and to physicians for the care of patients in drought area A during June, July and August. Grants to hospitals have been increased from 50 to 75 cents a day, while to physicians a maximum grant of $50 a month for transportation and emergency medicines is being allowed during the three-months' period.

Manitoba

DR. F. W. JACKSON, Deputy Minister of Health and Public Welfare, was recently appointed Director of Child Welfare.

Ontario

THE Ontario Medical Association has appointed a committee of eight to act in an advisory capacity to the Ontario Cancer Commission. Dr. Warren Lyman, of Ottawa, will act as chairman and the other members comprise Dr. T. C. Routley and Dr. H. H. Wookey, of Toronto; Dr. G. S. Cameron, Peterboro; Dr. G. A. Ramsay, London; Dr. J. K. McGregor, Hamilton; Dr. L. J. Austin, Kingston; and Dr. E. P. Secord, Brantford.

The British, Canadian and Ontario Dental Associations held their joint convention in Toronto from August 8th to 12th, inclusive. While the meeting officially concerned only these three groups, observers were present from the United States, the Irish Free State, Australia, New Zealand and other Empire points. Running concurrently with the dental convention was the annual gathering of dental nurses and assistants from all parts of Ontario.

The Board of Trustees of the Toronto Orthopaedic Hospital announces that the assets of that hospital have been amalgamated with those of the Board of Governors of the Toronto East General Hospital. The orthopaedic services of the Toronto Orthopaedic Hospital are being transferred to the Toronto East General Hospital, the fifth floor of which will be used for this work, while the nurses in training of the Orthopaedic Hospital will take up residence in the recently completed $100,000 nurses' home. It is planned eventually to build a six-storey convalescent and orthopaedic wing.

Quebec

ON the recommendation of Dr. Alphonse Lessard, Director of the Provincial Bureau of Health and Public Charities, and at the request of Dr. Sylvio Roch, head of the Board of Health of Lachine, radiographic apparatus will be installed in St. Joseph Hospital, Lachine, by the Provincial Government, for use in the anti-tuberculosis clinic.

Nova Scotia

THE Medical Society of Nova Scotia held its 79th annual meeting in conjunction with the annual meeting of the Nova Scotia Health Officers' Association from July 4th to 8th, inclusive, in Kentville. The Hon. G. H. Murphy, Minister of Health, addressed the health officers and the visiting speakers included Dr. R. D. Rudolf and Dr. J. W. Ross, of Toronto; Dr. Frank Lahey and Dr. G. E. Haggart, Boston; Dr. H. E. Britton, Moncton; and Dr. F. W. Tidmarsh, Charlottetown. A three-day "refresher" course in tuberculosis was conducted by Dr. A. F. Miller, of the Kentville Sanatorium.

CANADIAN NATIONAL EXHIBITION

Toronto, August 26th—September 10th, 1932

ANNUALLY reflecting the ever-increasing interest in public health in Canada, the Canadian National Exhibition again in 1932 presents an extensive series of health exhibits sponsored by the Ontario Department of Health and the various national agencies.

Ontario Department of Health

The exhibit of the Department of Health of Ontario will be found in the south-west angle of the Ontario Government Building, located in the south-west corner of the grounds. The following health activities have been singled out for emphasis:

PREVENTION OF DIPHTHERIA.—That immunization is a preventive against diphtheria is graphically shown by the Toxoid Exhibit, displayed by kind permission of the Local Board of Health of Hamilton.

SANITATION IN RURAL SCHOOLS.—Safe drinking water and sanitary disposal of sewage for rural schools are illustrated by means of models of school buildings of various sizes and types of construction.

CANCER.—One booth is devoted to education relating to cancer—prevailing rates and their trends in Ontario, Canada and other countries. Striking posters are on display and the following literature is available for distribution to the public:

- "What Everyone Should Know about Cancer."
- "The Prevention of Cancer."
- "The Doctor and the Cancer Patient."
- "A Word to You about Cancer."
- "Important Facts for Women about Tumours."
- "Cancer of the Mouth."

MILK SUPPLY. — The section on Milk stresses the value of milk as a food, and a mechanical device displays cards covering points in the production and distribution of clean, safe milk.

PUBLIC HEALTH NURSING.—A conference desk and a map showing the distribution and the types of service in Ontario municipalities will be a feature this year. An invitation to visit the booth is extended to all who are interested in community nursing.

Canadian Social Hygiene Council

The exhibit of the Canadian Social Hygiene Council in the Women's Building portrays the work done by the organization, and emphasizes the need for public education in health matters through the press, radio, moving pictures, literature and platform speaking. It also shows the cost of illness in Canada, both as to the number of people ill and the cost in dollars for their care. Wax models depict various communicable diseases and the necessity of periodic health examinations. Physicians will be in attendance each day to answer questions.

National Council of Women

The Public Health Committee of the National Council of Women will offer an interesting programme in the Women's Building on Wednesday afternoon, August 31st, from 2.20 to 4.30 o'clock. Dr. Helen MacMurchy will give an address on "Mental Health in Hard Times," stressing mental health in terms of recreation rather than in terms of medicine. The programme will cover ages from pre-school to junior adult.

In addition to offering a unique opportunity for the presentation of health facts to the general public, the Exhibition furnishes inspiration for the medical officer of health, the public health nurse and the sanitarian, who can adapt to their local needs and conditions the material there shown.

CURRENT HEALTH LITERATURE

These brief abstracts are intended to direct attention to some articles in various journals which have been published during the preceding month. The Secretary of the Editorial Board is pleased to mail any of the journals referred to so that the abstracted article may be read in its entirety. No charge is made for this service. Prompt return (within three days) is requested in order that the journals may be available to other readers.

The Effect of Variations in Temperature in 37°C. Incubators on Bacterial Counts from Milk — Disconcerting results have been obtained in tests of the suitability of commonly used types of incubator for the determination of bacterial counts from milk. Faulty design and internal irregularities of temperature play an important part in producing discrepant counts.

Breed, Robert S., Ph.D., F.A.P.H.A., and Pederson, Carl S., Am. J. Pub. Health, v. XXII, No. 7 (July), pp. 745-748.

Factors in Food Influencing Hemoglobin Regeneration. I. Whole Wheat Flour, Prepared Bran, and Oatmeal—Nutrition anaemia was induced by milk feeding. Cure was brought about by supplementing with whole wheat, prepared bran or oatmeal. The capacity of the supplement to regenerate hemoglobin was roughly proportional to the amount of iron it contained. Copper was found to play a part as well as iron, and evidence suggesting other factors was also obtained.

Rose, Mary Swartz, and Vahlteich, Ella McCollum, J. Biol. Chem., v. XCVI, No. 3 (June), pp. 593-608.

Present Situation in France of Biological Prophylaxis and Treatment in certain Contagious Diseases, especially Whooping Cough and Measles—The Nicolle whooping cough vaccines have been extensively employed in France and high percentages of success (95 to 100 per cent) have been obtained when the vaccine has been employed for prophylaxis. Three injections, on alternate days, are necessary and the vaccine should not have been killed by heat. Therapeutically, vaccines have yielded clear-cut and satisfactory results when employed not later than the second and third weeks of the disease.

The discussion of Dr. Pierret's paper reveals differences in practice and in results in England. Trials of whooping cough vaccine (Bordet) in London hospitals have been most disappointing. In the prophylaxis of measles, larger doses of convalescent serum (age multiplied by two in c.c.) have been found necessary than are employed in France. On the other hand, adult serum, in doses exactly double those for convalescent serum, has been found almost as efficient when injected during the first three days.

Pierret, Robert, M.D., Proc. Roy. Soc. Med., v. XXV, No. 8 (June), pp. 1329-1342.

The Management of Posture in Children—Correct posture, according to the author, is one of the most important and vital factors in child welfare. Measures for the prevention and for the correction of faulty posture are described in detail.

Wiggins, Reginald H., M.D., C.M., Canad. M.A.J., v. XXVII, No. 1 (July), pp. 47-51.